Engineering Library

CONSTRUCTION TRENDS

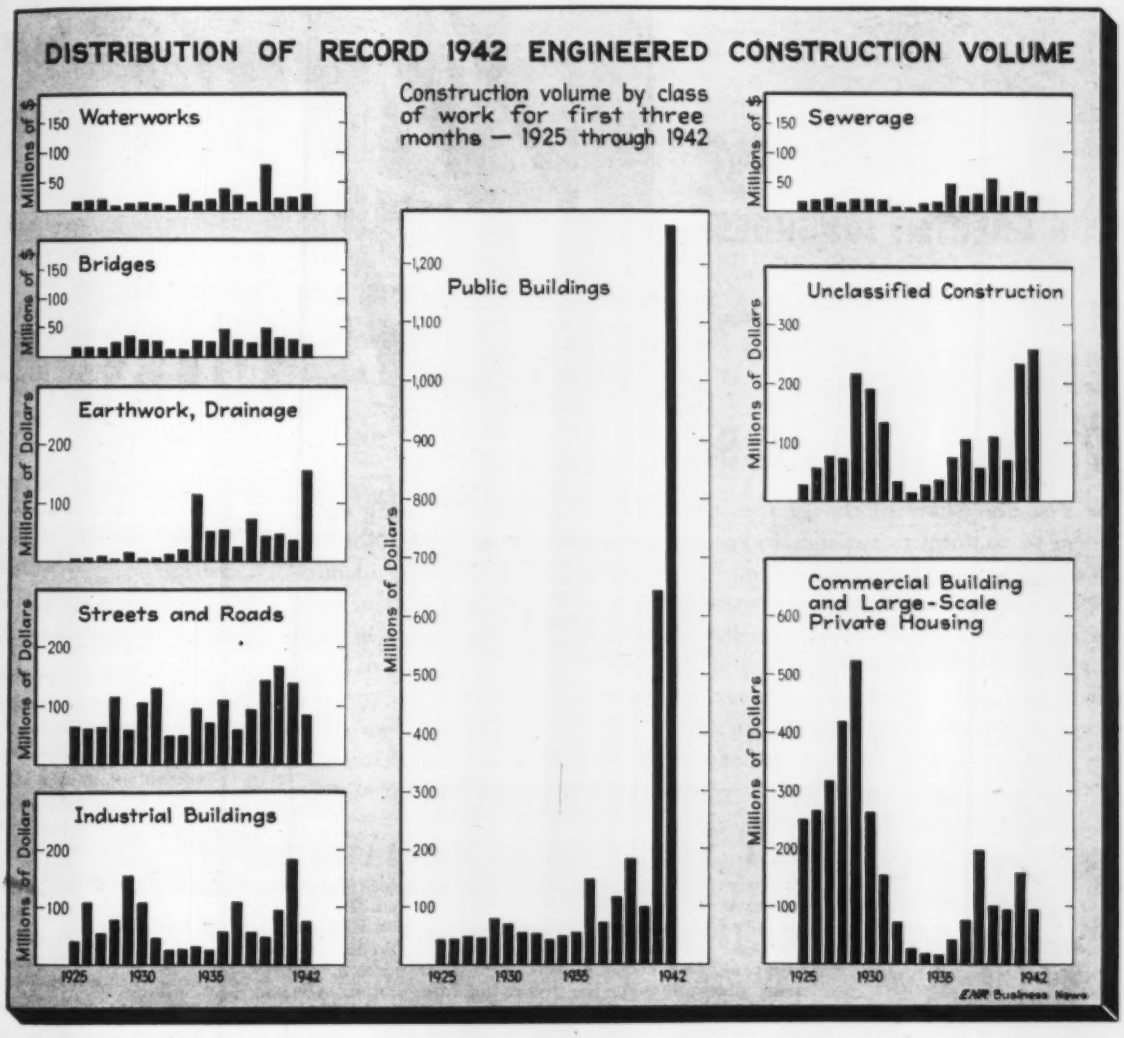
Notes on significant movements in the construction industry

Opening Quarter Construction Records Shattered

ENGINEERED CONSTRUCTION in 1942 shattered all opening quarter records and piled up a volume of $1,993,100,000 for the period, an increase of 36 percent over the previous high reported for the first quarter in 1941.

As predicted by *Engineering News-Record* at the beginning of the year, over four-fifths of the huge construction total was concentrated in federal projects, primarily of a military nature. Private work accounted for 9.4 percent of the volume, and state and municipal made up the balance, 8.3 percent, both well below last year's marks.

The three classes of engineered buildings—public, industrial and commercial—were responsible for 72 percent of the 1942 volume, and registered a 47 percent gain over the combined total for the corresponding 1941 quarter. Over $1,262,000,000 of the engineered buildings were public structures; $77,300,000 were private industrial plants; and $91,300,000 were commercial buildings and large-scale private housing developments.



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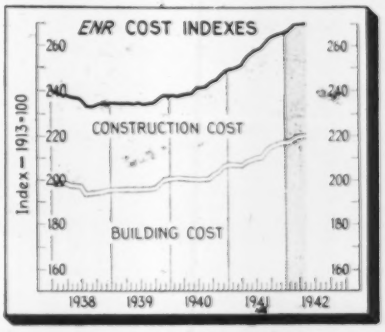
MONTHLY CONSTRUCTION BUSINESS SUMMARY

ENR CONSTRUCTION VOLUME AND NEW CAPITAL . . . FHA MORTGAGES

(,000 omitted)	March 1941	March 1942	% Change	Three Months 1941	Three Months 1942	% Change
Total Construction	$452,430	$729,485	+61.0	$1,461,248	$1,993,088	+36.0
Private Construction	77,417	67,299	−13.0	390,016	187,704	−52.0
Public Construction	375,613	662,186	+76.0	1,071,232	1,805,384	+68.5
Federal	279,839	616,398	+120.0	748,658	1,639,685	+119.0
Total New Productive Capital	$653,542	$46,991	−93.0	$1,332,653	$1,419,454	+6.5
Private Investment	89,932	45,571	−49.0	220,652	162,250	−26.0
Federal (non-federal work)	110	1,420	+1,190.0	39,501	15,249	−61.0
Federal (federal work)	563,500	.....	.....	1,072,500	1,241,955	+16.0
FHA Mortgages Selected for Appraisal (Title II)	$138,231	$75,050*	−46.0	$323,929	$196,423*	−39.0

*Preliminary.



CONSTRUCTION COSTS . . . WAGE RATES . . . PRICES

	April 1941	April 1942	% Change	Change March to April 1941 Mar	1941 Apr.	1941 %	Change March to April 1942 Mar	1942 Apr.	1942 %
ENR Construction Cost Index, 1913 = 100‡	252.40	271.78	+7.7	250.71	252.40	+0.7	269.71	271.78	+0.8
ENR Building Cost Index, 1913 = 100‡	208.60	219.55	+5.2	207.88	208.60	+0.3	218.88	219.55	+0.2

‡*Does not reflect increased costs due to more overtime, lower labor efficiency, delivery delays, etc.*

ENR 20-CITIES' AVERAGE

Common Labor	$0.725	$0.788	+8.7	$0.716	$0.725	+1.3	$0.780	$0.788	+1.0
Skilled Labor (Av 3 trades)	1.480	1.541	+4.1	1.468	1.480	+0.8	1.538	1.541	+0.2
Bricklayers	1.564	1.645	+5.2	1.561	1.564	+0.2	1.638	1.645	+0.4
Structural Ironworkers	1.556	1.602	+3.0	1.535	1.556	+1.4	1.599	1.602	+0.2
Carpenters	1.320	1.376	+4.2	1.307	1.320	+1.0	1.376	1.376	0
Cement, per bbl	$2.52	$2.60	+3.2	$2.52	$2.52	0	$2.60	$2.60	0
Reinforcing steel, per cwt	2.56	2.62	+2.3	2.56	2.56	0	2.61	2.62	+0.4
Struct. steel shapes, base	2.10	2.10	0	2.10	2.10	0	2.10	2.10	0
Sand, per ton	1.17	1.21	+3.4	1.17	1.17	0	1.21	1.21	0
Lumber, 2x4 Fir, per M ft	40.59	47.88	+17.9	40.59	40.59	0	47.80	47.88	+0.2
Lumber, 2x4 Pine per M ft	37.66	42.29	+12.3	37.85	37.66	−0.5	42.06	42.29	+0.5
Brick, common per M	14.50	15.33	+5.7	14.50	14.50	0	15.28	15.33	+0.3
Ready-mixed concrete, c.y.	6.94	7.19	+3.6	6.93	6.94	+0.1	7.20	7.19	−0.1
Struct clay tile, 3x12x12	74.34	76.62	+3.1	74.34	74.34	0	75.91	76.62	+0.9
Paving asphalt, cars ton	14.29	15.36	+7.5	14.24	14.29	+0.4	15.31	15.36	+0.3

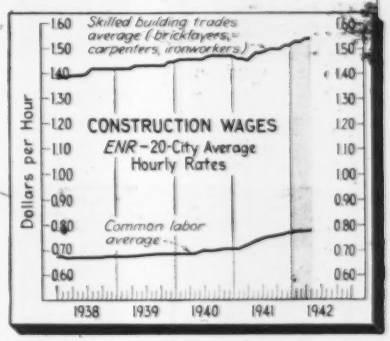
ENR INDEX NUMBERS

Base = 100	Construction Cost 1913	Construction Cost 1926	Building Cost 1913	Building Cost 1926	Volume '13	Volume '26
April, 1942	271.78	130.64	219.55	118.68		
Mar., 1942	269.71	129.65	218.88	118.32	578	253
Feb., 1942	269.41	129.51	218.44	118.08	507	222
Jan., 1942	267.63	128.65	217.12	117.37	402	176
Dec., 1941	266.18	127.94	216.37	116.96	217	95
Nov., 1941	265.13	127.93	216.54	117.05	282	124
Oct., 1941	264.49	127.13	215.92	116.72	263	115
Sept., 1941	263.12	126.48	214.58	116.00	419	184
Aug., 1941	260.41	125.18	212.45	114.84	434	190
July, 1941	258.18	124.11	210.22	113.64	635	278
June, 1941	256.79	123.44	209.41	113.20	492	216
May, 1941	255.55	122.84	209.24	113.11	275	121
April, 1941	252.40	121.33	208.60	112.76	322	141
Mar., 1941	250.71	120.52	207.88	112.37	386	169
1941 (Av.)	257.84	123.95	211.46	114.32	375	164
1940 (Av.)	241.96	116.31	202.81	109.64	269	118
1939 (Av.)	235.51	113.21	197.44	106.73	211	92
1938 (Av.)	235.86	113.34	196.83	106.40	197	86

MATERIAL SHIPMENTS . . . BUILDING PERMITS

	March 1941	March 1942	% Change	Feb 1942	% Change Feb.-Mar.
Lumber (% wk seas av 1935–'39) N.L.M.A.	139.5	145.8	+4.5	154.5	−5.6
Steel (% operating capacity) A.I.S.I.	98.9	97.9	−1.0	97.1	+0.8

	February 1941	February 1942	% Change	Two Months 1941	Two Months 1942	% Change
Fabricated Structural Steel, tons, A.I.S.C.	161,354	153,732	−4.7	325,944	312,612	−4.0
Cement, thous. bbl., U.S.B. of M.	7,456	8,285	+11.1	15,440	17,405	+12.7
Building Permits, Dun & Bradstreet (,000 omitted)	$93,601	$88,486	−5.5	$199,159	$150,809	−24.3



COST OF LIVING INDEXES

	February 1941	February 1942	% Change	Jan 1942	% Change Jan.-Feb
Cost of Living Index, N.I.C.B.	86.1	95.2	+10.5	94.5	+0.7
Rent (Housing) Index, N.I.C.B.	87.7	90.4	+3.1	90.1	+0.3
Total Employment (est.) thous., B.L.S.	37,448	39,842	+6.3	39,871	−0.1
Construction Employment (est.) thous., B.L.S.	1,678	1,632	−2.7	1,658	−1.6

ENGINEERING CONSTRUCTION CONTRACTS——ENGINEERING NEWS-RECORD——MARCH, 1942

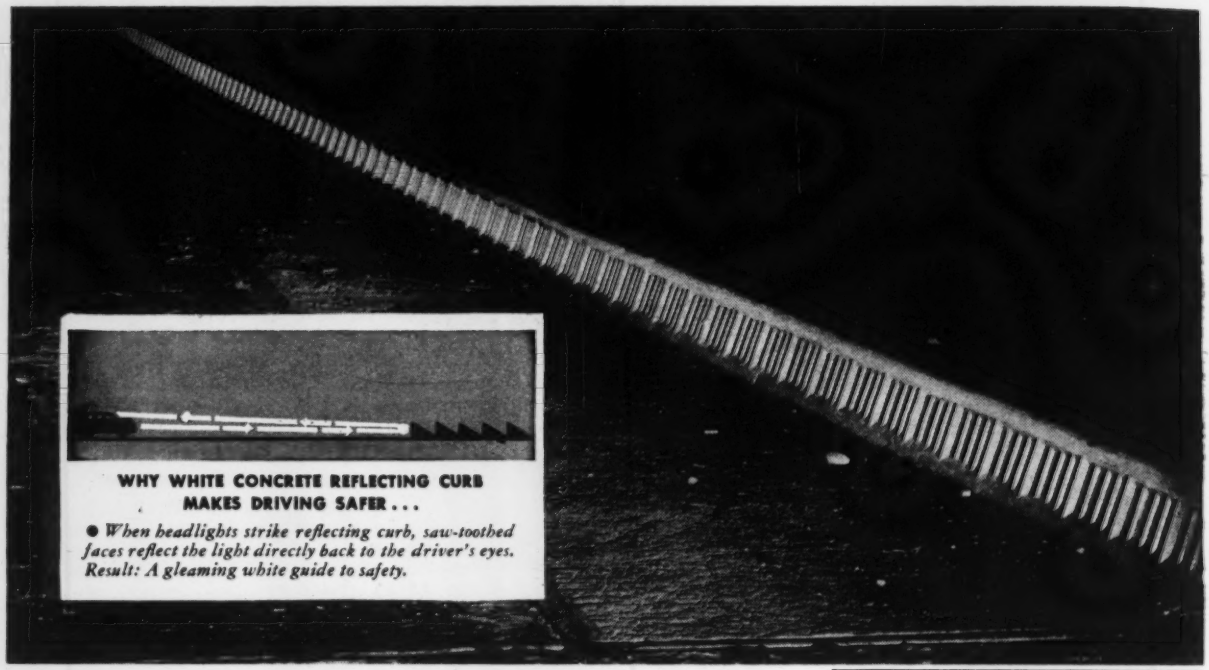
Engineering News-Record *reports projects of the following minimum costs —waterworks, excavation, drainage and irrigation,* $15,000; *other public works,* $25,000; *industrial buildings,* $40,000; *other buildings,* $150,000

Four Weeks—Thousands of Dollars (000 Omitted)

Public Works	New England	Middle Atlantic	South	Mid West	West of Mississippi	Far West	United States March 1942	United States Three Months 1942	United States Three Months 1941	Canada
Waterworks	973	740	2,184	349	4,490	406	9,142	25,714	20,741	134
Sewerage	92	1,753	1,363	1,979	1,292	2,409	8,888	21,468	31,392	439
Bridges, public	128	2,038	983	756	480	1,030	5,415	18,659	26,494	25
Earthwork and waterways	334	489	111	280	1,017	4,661	6,892	153,520	38,039	375
Streets and roads	93	5,422	11,162	11,867	5,841	2,863	37,248	85,761	136,567	2,180
Buildings, public	11,419	54,662	126,306	73,990	206,023	50,838	526,238	1,262,092	638,414	1,860
Unclassified, public	5,791	15,830	16,483	1,989	21,031	7,239	68,363	238,170	179,585	5,218
Total public	**21,830**	**80,934**	**158,592**	**91,210**	**240,174**	**69,446**	**662,186**	**1,805,384**	**1,071,232**	**10,231**
Federal government (included in above classifications)	21,498	69,101	149,066	84,169	230,144	62,420	616,398	1,639,685	748,658	.....
Private										
Bridges, private	.....	.....	.....	.....	.....	100	100	205	2,803	.....
Buildings, industrial	1,791	6,352	7,260	5,135	748	3,223	24,509	77,378	157,761	4,594
Buildings, commercial	5,700	7,396	2,769	3,451	8,508	9,926	37,750	91,305	155,788	.....
Unclassified, private	350	1,551	.....	165	2,364	510	4,940	18,876	49,664	.....
Total private	**7,841**	**15,299**	**10,029**	**8,751**	**11,620**	**13,759**	**67,299**	**187,704**	**390,016**	**4,594**
Total Engineering Construction:										
March, 1942 — (4 weeks)	**29,671**	**96,233**	**168,621**	**99,961**	**251,794**	**83,205**	**729,485**	.....	.....	**14,825**
February, 1942 — (4 weeks)	15,617	78,540	117,572	128,508	134,346	160,240	634,823	.....	.....	9,039
March, 1941 — (4 weeks)	22,362	100,424	74,677	120,821	98,145	36,000	452,430	.....	.....	26,791
Three Months — 1942	**69,562**	**315,530**	**515,701**	**317,212**	**464,698**	**310,385**	.....	**1,993,088**	.....	**31,720**
Three Months — 1941	80,643	336,104	289,798	331,071	249,387	174,245	.....	.....	**1,461,248**	42,736

HOW TO HELP KEEP UNCLE SAM'S TRAFFIC ROLLING SAFELY

White Concrete Reflecting Curb on military access roads and strategic highways helps reduce accidents and speeds traffic flow by increasing driving visibility



WHY WHITE CONCRETE REFLECTING CURB MAKES DRIVING SAFER . . .

● *When headlights strike reflecting curb, saw-toothed faces reflect the light directly back to the driver's eyes. Result: A gleaming white guide to safety.*

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Only reflecting curb can do this. Smooth curb wastes the light. It reflects it forward, away from the driver, and visibility is poor. Reflecting curb conserves the light. It directs it back to the driver, and visibility is high.

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Facts to remember about White Concrete Reflecting Curb

1. Adequately defines the road by day.
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3. Is moderate in first cost and low in maintenance cost.
4. Is built of white concrete because (1) white surfaces reflect, do not absorb light and (2) white concrete provides sharp contrast to surrounding objects.

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ENR-M-29

The Week In Engineering and Construction

ENGINEERING NEWS-RECORD • APRIL 9, 1942 • VOLUME 128 • NUMBER 15

Public Work Reserve becomes local plan unit in shakeup

Cut off from WPA, agency is converted into practical planning unit to encourage local governments to look to community needs that can be presently financed.

The Public Work Reserve set up some months ago by the Federal Works Agency with Works Progress Administration financing has been divorced entirely from the WPA and reorganized as a joint unit of FWA and the National Resources Planning Board.

The Public Work Reserve was intended to encourage local governments to accumulate reservoirs of construction projects which could be carried out as part of a post-war public works program. It had only limited funds and therefore in general confined itself to gathering lists of projects, but it was hoped that it would provide the framework for a more impressive organization if Congress passed the administration-supported Wagner Planning Bill. This bill would have authorized substantial sums for advance works planning, but it was voted down by Congress.

The new unit, known as the Local Public Works Programming Office, is attached jointly to the office of the Federal Works Administrator and to Frank Herring's Public Works Planning Division of NRPB, and is financed from the funds of the two agencies. It differs from the Work Reserve in adopting a more realistic approach to planning in advance.

Instead of simply gathering a reservoir of projects, it encourages local governments to draft a six-year plan of public works which it proposes to undertake with funds now in sight, without regard to any hypothetical federal program. This six year plan would start with the current year and in its early years would, necessarily, concentrate on projects connected with the war. Desirable non-war projects would be deferred to the later years of the program. The plan would be revised each year so that it would always extend ahead six years.

The theory behind this approach is that the simplest test of whether a project is a good one for a federally-aided works program is whether the local agency would carry it out with its own funds. Thus, if a PWA-type program is initiated after the war, the needed reservoir of projects can be obtained by telescoping the six-year plan.

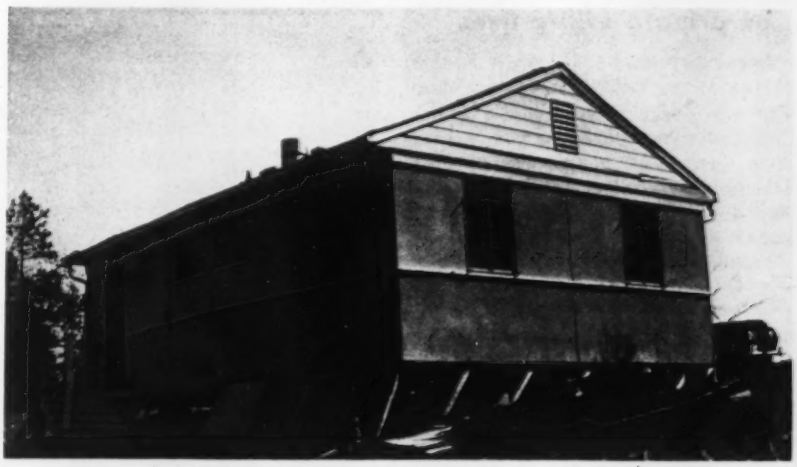
The federal programming office will confine itself to giving technical aid on the mechanics of planning to responsible state and local government officials and agencies. Choice of projects will be entirely a local responsibility. The organizational structure of the new unit has not been finally determined, but for the present the regional and state offices of the former public work reserve are being used.

Approve funds to ease capital housing jam

Expenditure of $50,000,000 to provide housing and municipal public works to relieve war congestion in Washington is authorized in amendments to the Lanham defense housing act passed by Congress last week and now awaiting Presidential signature.

The present Lanham act, under which most war housing is being built, authorizes federal construction of housing for war workers and families of enlisted men, but makes no provision for federal employees.

The new measure would authorize the National Housing Agency to build $30,000,000 worth of housing in and near the District of Columbia and would also authorize the Federal Works Agency to expend $20,000,000 on schools, hospitals, sewers, and similar public works in the district. In the case of both housing and of general public improvements, the money is to be expended under the terms of the existing Lanham act.



Demountable houses prove sturdy in high wind

Although moved about 3 ft. in a recent windstorm of almost cyclonic volume, the above TVA-designed demountable house near Muscle Shoals took the violent shakeup without serious damage. (ENR May 1, 1941, p. 706.)

One of a group of 150 built in 1941 to house workers in the area, the building is of frame structure with wallboard exterior and interior, consisting of three-dimensional sections which were trucked to the site and assembled by bolting. The high wind broke the foundation skirting and carried the house forward about 3 ft., but it moved as a solid mass. After the house came to rest, windows and doors still opened, bolted section joints between floor and wall were still together and practically all wallboard remained intact. Damage was for the most part confined to the loss of shingles from the roof and to the skirting of the foundations.

Flexible building codes urged for war's duration

Cities in defense areas, where most of the building construction to be permitted during the war will take place, have been advised by the American Municipal Association to adopt an emergency ordinance waiving existing building code provisions that conflict with requirements of the defense housing critical list that was recently issued by the War Production Board.

The WPB list (*ENR* Mar. 19, 1942, p. 447) limits use of electrical, plumbing and other building materials to such an extent that it is almost impossible to build a house in conformity with provisions of the more stringent municipal building codes, the Association reports. Adoption of an emergency ordinance will provide a means by which priority assistance for essential defense housing can be made available immediately, without forcing local officials or builders to ignore or violate building codes. It will also permit the automatic revival of all former building code standards immediately upon appeal of the ordinance, or upon expiration of the present war-time emergency.

Such an ordinance is under consideration in Milwaukee, Wis., where a proposal has gone before the city council to create a committee to rule on the acceptability of various substitutes for prohibited materials.

• • •

Approve interconnection of private utility lines

In the first order issued under Section 202(d) of the Federal Power Act since war was declared, the Federal Power Commission has authorized construction of a permanent interconnection near Somerset, Mass., between the facilities of New Bedford Gas and Edison Light Co., and those of the Montaup Electric Co.

Section 202(d) empowers the Commission to approve connections for emergency use only without subjecting the party or parties to its jurisdiction because of such connection. The order states that the connection, of at least 25,000 kilovolt-amperes capacity, will provide for the interchange of electricity between the two companies to assure an adequate and continuous power supply for war industries in southeastern Massachusetts.

The New Bedford Gas Co., supplies electric service in Bristol and Plymouth counties, and sells at wholesale to distributors in Barnstable, Dukes, and Plymouth counties. The Montaup Electric Co., operates a generating plant in Somerset, and sells at wholesale to three other electric companies operating in Massachusetts and Rhode Island.

Corps of Engineers asks surveying tools

The War Department has issued an appeal to the public for surveying instruments for the use of the Corps of Engineers in construction work, with particular emphasis on transits, levels and plane tables. All surveying equipment in the hands of commercial firms has been purchased by the Corps of Engineers, but there is still an acute shortage. The Corps is now prepared to rent, purchase or borrow instruments in the hands of private individuals or firms, all sales to be made with or without the recapture clause, as the owners decree. Maj. R. L. Richardson, Office of the Chief of Engineers, is in charge of the procurement effort.

Coulee power plant marks year of operation

During its initial year of service, completed in March, the power plant at Grand Coulee Dam has delivered more than 400,000,000 kw.hr. of energy, John C. Page, commissioner of the Bureau of Reclamation said in a recent report to the Secretary of the Interior.

The total production, Page said, would provide sufficient energy to manufacture 20,000 tons of aluminum, or enough to build 1,200 four-motored bombers or 6,400 fighter planes.

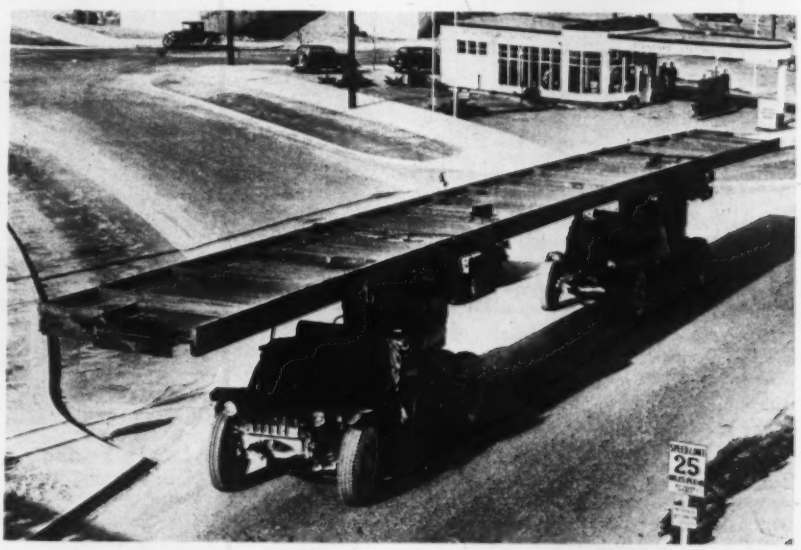
Mexico adds to extensive general works program

Added to an already extensive general construction program were a number of important jobs announced by municipalities and the government of Mexico last week.

The work announced included:

A $2,000,000 modernization program at Vera Cruz, Mexico's leading and oldest port, to include street paving, construction of a hospital, new schools and reconditioning of existing schools, additions to water service, expansion of electric illumination, two public markets and a municipal slaughter house: announcement of imminent resumption of construction of the Southeastern Railroad connecting Mexico City and Campeche and Yucatan states by rail at an estimated cost of $4,550,000; resumption of construction of the Tequixquiac tunnel to relieve flood peril for the federal district, which includes Mexico City; and the purchase of two dredges in New York to be added to the government's dredging fleet for general port improvement work soon to be started.

In addition, the National School of Mining, third oldest in the world, is to be reconditioned as the result of a $22,500 cash gift made by Gen. Maximino Avila Camacho, minister of communications and public works and brother of the president, to the National University of Mexico which is custodian of the historic building. The building housing the school, in downtown Mexico City, has been near collapse for some time.



Truck team carries 37-ton plate girder

The last construction trestle girder removed from Grand Coulee Dam is shown en route to Pacific Coast shipyards for conversion into ship parts. This girder, largest of those making up the trestle, was 100 ft. long, 8 ft. high and weighed 74,000 lbs. Contractors placed the bulky load on timber cribbing, securely fastened on the chassis of two trucks. Close team work between the drivers of the vehicles was of prime importance.

Labor protests win some modification of FWA program opposing plastering

Snyder tells heads of three unions agency will consider use of plaster on semi-permanent structures if no waste is involved.

In the face of labor protests, the Federal Works Agency is reconsidering the possible use of its plastering in some types of buildings constructed as part of the emergency community facilities program.

The dispute arose over FWA opposition to the use of plaster when it established the simplified standard designs for buildings (ENR, April 2, p. 9). Two standards were established — a purely temporary wooden building and a simple masonry building, to be composed of standard units, for use where some possibility of a post-war utility was thought to exist. The standards were drawn to eliminate all "frills" such as plaster.

This decision was promptly protested by the plasterers' unions—the Lathers, the Operatives Plasterers, and the Bricklayers and Plasterers. In contrast to the general situation in the building trades, there is considerable unemployment among these crafts as a result of the temporary nature of much war building and the increasing use of such finishes as plasterboard.

Responding to these protests, Assistant FWA Administrator Baird Snyder last week wrote to the presidents of the three unions, saying that FWA only intended its flat prohibition of plastering to apply to the wooden structures. Snyder said that on the semi-permanent buildings consideration would be given to the use of plaster if it proved to be of any special merit; and if it would not involve any waste of labor, materials, or transport facilities.

This answer is not believed likely to prove satisfactory to unemployed plasterers, but it is not thought in Washington that any serious difficulties will arise in connection with FWA projects. It is felt that the other building trades will not be inclined to support drastic action—particularly in view of the policy adopted some months ago by the Building Trades Department that members of trades where there is unemployment be transferred to trades where shortages exist.

Water rates reduced to permit "Victory Gardens"

Any consumer served by the Los Angeles Water Department may now plant a "Victory Garden," assured that the cost of extra water used will be charged at the same rate as that paid by farmers who irrigate with Los Angeles aqueduct water. The reduced charge is made under a plan for credit allowance on the bill of each consumer, based on the consumer's own statement as to the area he plans to irrigate, and assumes that the use will be 24 in. per season.

The city's domestic rate is 14.8 cents per hundred cubic feet and the irrigation rate is about 10 cents per hundred cubic feet less. As a check, meter readers are instructed to satisfy themselves that a garden has been planted.

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Massachusetts board receiving registrations

The Board of Registration of Professional Engineers and of Land Surveyors for the Commonwealth of Massachusetts, created by legislative act in October, 1941, has been formed and is now receiving applications for registration at its offices in the State House, Boston.

Members are Ralph F. Gow, chairman; Gustavus J. Esselen, vice chairman; Holcombe J. Brown, Karl B. McEachron and Albert Haertlein, secretary.

Montana road maintenance appropriation unchanged

Howard W. Holmes, Montana state highway engineer, said recently that budgeted maintenance appropriations of $4,100,000 for the period from January 1, 1942, to June 30, 1943, will not be altered despite an expected 35 percent reduction in gasoline tax revenue for that period.

Senate approves billion for Navy public works

A billion dollars worth of naval public works is authorized by a bill which the Senate passed last week. As with all recent authorizations of this character, no detailed breakdown of the proposed expenditures has been made public. Nearly $200,000,000 will go for expansion of aviation facilities. For storage of liquid fuel, $175,000,000 is allotted, and a like sum for ordnance storage. Another $139,000,000 is for general storage. Largest remaining item is $117,000,000 for personnel training and housing. A $46,000,000 floating drydock program is authorized.

Design competition for Washington D. C. bridge

Late this month the commissioners of the District of Columbia will select an engineer for the $4,000,000 bridge across the Anacostia River in Washington. Selection will be made on the basis of competitive designs submitted by four engineering firms as a result of invitations extended several months ago. The firms are: Parsons, Klapp, Brinckerhoff & Douglas of New York, Modjeski and Masters of Harrisburg, Pa., Sverdrup & Parcel of St. Louis, Mo. and Harrington & Cortelyou of Kansas City, Mo. Each has been asked to work in association with an architect.

Each of these firms will submit preliminary designs for a bridge, for which they will be paid $2,500. The District's engineers will then prepare cost estimates by applying a set of unit prices to all the quantity schedules. Finally a choice will be made among the designs on the basis of economy of cost, economy of materials, appearance, time to build, and the fee for which the firm will provide complete engineering service.

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Court upholds Illinois building authority

Constitutionality of a new law which created an Illinois Public Building Authority was upheld last week in a circuit court at Springfield. The purpose of the authority is to purchase, construct, maintain and operate buildings in Springfield and Chicago for use as state office buildings. It is empowered to issue $12,000,000 in revenue bonds to finance the operation of such buildings.

The agency is composed of Governor Green and other state officials.

Powers of members of the board were challenged by State's Attorney A. H. Greening, in a quo warranto suit filed last year. The court's decision said that a state official appointed exofficio to another board had not been named to a new position, but merely had assumed new duties under his state office.

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Abolish city's public works, inspector offices

The office of director of public works and of buildings inspector, at Greensboro, N. C., will be abolished as a war economy move May 1, to save the city an estimated $14,000 annually in salaries and operating costs.

City Manager C. W. Smedburg said the duties of the public works director will be consolidated with those of the city manager, while H. L. Medford, city engineer, will assume work of the building inspector's office.

A. N. Talbot, research leader, dies

Arthur Newell Talbot, professor emeritus of engineering at the University of Illinois, died in Chicago on April 3 after a short illness. He was in his 85th year. Though he retired from regular teaching in 1926, Dr. Talbot continued to take an active part in research and in the deliberations of many engineering and scientific organizations, up to the time of his last illness. He did not give up his direction of the track stress studies of the American Railway Engineering Association until last year when he resigned as chairman of the special committee that he had headed for 27 years.

Dr. Talbot was born in Cortland, Ill., in 1857, and studied civil engineering under Ira O. Baker at the University of Illinois, receiving his bachelor's degree in 1881. After four years of railroad work in the West he returned to the university to begin a notable career as a teacher, becoming professor of municipal and sanitary engineering in 1890. Early in that period he took an active part in engineering research and fostered the establishment of facilities at the university for hydraulic studies and the testing of construction materials. This early work was climaxed in 1938, when the university changed the name of its great materials testing laboratory to the "Arthur Newell Talbot Laboratory."

Evidence of the versatility of Dr. Talbot's early studies is found in the now well known Talbot formulas for determining maximum rates of rainfall and for fixing the areas of waterways, also the "Talbot spiral" widely used for railroad curves. In 1903, when reinforced concrete was only beginning to be recognized as a structural material, Dr. Talbot began experimental work in this field that soon placed him among the leaders in the development of rational designs for structures of reinforced concrete. For many years he represented the American Society of Civil Engineers on the Joint Committee on Concrete and Reinforced Concrete. Most extensive of Dr. Talbot's research work was that as head of the A. R. E. A. committee on stresses in track, work that included extensive field and laboratory tests by a large staff and developed much fundamental knowledge concerning railroad track.

Most of the engineering and scientific societies in which Dr. Talbot took an active part elected him to honorary membership in recent years. He was elected president of the American Society for Testing Materials in 1913-14, and of the American Society of Civil Engineers in 1918. He was the recipient of many medals and awards, including the John Fritz Medal in 1937, the highest award in the engineering field.

Arthur Newell Talbot

Tunnel fire halts Penn turnpike traffic

Traffic on the Pennsylvania Turnpike was stopped for about five hours April 5 when a trailer-truck loaded with rubberized cables, paint and varnish caught fire midway through the 5,700-ft. Laurel Hill tunnel, 65 miles east of Pittsburgh.

Great heat in the confined space hampered firemen and caused damage estimated at $10,000 to the tunnel. Water tanks, placed under the tunnel for fire purposes, were utilized in fighting the blaze.

The fire caused the first traffic delay since the superhighway was opened.

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Reforestation slowed

Scarcity of rural labor and concentration on foodstuff production has seriously slowed reforestation on private land in Kentucky, State Forester Kenneth G. McConnell has announced. Urging that tree planting be continued to prevent soil erosion as well as to form a potention lumber supply, Mr. McConnell said that last year 1,077,000 trees were planted, but that unless the demand greatly increases before the planting season ends, less than half of that number would be set out this year.

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Abandon lighting program

An extensive street lighting installation program planned for 1942 by Saskatoon, Saskatchewan, has been abandoned due to recent orders from the Metals Controller at Ottawa which clamped tight restrictions on the use of conduits and wires for non-war purposes.

OPA opens field office in 16 major cities

Expanding its field operations beyond the 11 regional offices already established, the Office of Price Administration has announced the establishment of 16 field offices. The move is made, according to Frank Bane, director of the Division of Field Operations, to increase service to the public and industry.

Previously, OPA field operations—except for rationing—have been conducted by the regional offices, each covering a group of states. Through the field offices, OPA will have staff men who can devote full time to the price administration problems of any given community. Rationing will continue to be administered through the State Rationing Administrators and the local rationing boards.

Cities in which the field offices are located are: Hartford, Conn.; Newark, N. J.; Buffalo, N. Y.; Pittsburgh, Pa.; Birmingham, Ala.; Memphis, Tenn.; Detroit, Mich.; Milwaukee, Wis.; Indianapolis, Ind.; St. Louis, Mo.; New Orleans, La.; Houston, Tex.; Salt Lake City, Utah; Los Angeles, Cal.; Seattle, Wash., and Richmond, Va.

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New York bridge, tunnel tolls show gain for 1941

Despite the gasoline curtailment of last fall, and mounting restrictions on nonessential automobile use as 1941 ended, traffic and revenue from the two vehicular tunnels and four bridges in the New York metropolitan area operated by the Port of New York Authority mounted sharply in 1941 over 1940, according to the Authority's 21st annual report.

During 1941, a total of 30,600,567 vehicles used the six interstate tunnels and bridges, a rise of 3,204,166 over 1940. Net revenues, showing a rise of 36 percent, were $8,740,131.32. Slightly more than three-quarters of the traffic consisted of passenger automobiles.

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Mexico limits all road contracts to own citizens

All Mexican government contracts for road work, including those on the Mexican sections of the Pan American Highway, have been and will be awarded exclusively to Mexicans, the Ministry of Communications and Public Works has announced. General Maximino Avila Camacho, Minister, said his announcement was made to deny rumors that some of these contracts are to be given to foreigners and that contracts now held by Mexicans might be cancelled in favor of United States firms.

Engineer Corps considers equipment rental rate

Establishment of a standard schedule of rental rates to govern the use of equipment not owned by the construction contractor is being considered by the Corps of Engineers. Under a plan now being studied by the corps, the War Production Board, and the Office of Price Administration, rates for all rental of equipment from third parties would be based on the "Green Book" of the Associated Equipment Distributors.

At present, rates for third-party rentals are established by competitive bidding, and the lease includes a recapture clause. Rental rates for contractor-owned equipment under fee contracts are set according to a table largely derived from the Associated General Contractors' equipment ownership cost tables. Whether the proposed new arrangement on third-party rentals would modify the recapture situation is not yet known, but an early ruling on this phase of the arrangement is expected.

WPA airport program improves 900 sites

Howard O. Hunter, Commissioner of Work Projects, said in a recent report that the WPA airport construction and improvement program has bettered the facilities of the nation's flying forces at 900 sites, including 350 sites where projects are now in progress. The current work represents a great part of all wartime airport construction and improvement for the armed forces, Hunter said. The program, now in the construction phase comprises, almost without exception, projects for war and navy department airports and for civilian fields which the army and navy are using or will use and have certified to be of military importance for the nation's war program.

Minnesota offers men for Alaska road

Governor Harold E. Stassen of Minnesota early last week offered to loan to the federal government the engineering staff of the Minnesota Highway Department for surveys and construction of the Alaska Highway.

Following the governor's offer, representatives of the federal governments of the United States and Canada met on Saturday with Minnesota officials to explore the possibilities of the proposal. The conference was held in the office of A. E. Palen, district engineer, Public Roads Administration at St. Paul. Other representatives of the PRA were J. S. Bright of the San Francisco region and A. C. Clark, personal representative of Thomas H. MacDonald, commissioner of public roads. Roy M. Smith, deputy minister of highways of Ontario, represented Canada and M. J. Hoffmann was the representative for the Minnesota Highway Department.

Commissioner Hoffmann was asked to make an immediate survey of contract equipment available in the Northwest, also to accept and file applications from skilled workers for the project. It is understood that a survey of road-building equipment was begun recently by the Associated General Contractors in anticipation of an early call for bids on the work.

The Public Roads Administration which is to have charge of the permanent construction, can employ contractors from either country for the work. Calls for bids now are expected to be made in May.

After the meeting in St. Paul, J. S. Bright and A. C. Clark left for Fort St. John, British-Columbia, the point from which the new road will start (*ENR* April 2, 1942, p. 515).

New bridge under way near Jefferson Memorial

Construction of foundations for a new bridge over the Tidal Basin in Washington, D. C., (above) has been complicated by old substructure works for the gates and retaining walls of the basin. The bridge piers rest on wood pile foundations which were constructed inside a cofferdam consisting of an earth dike on the basin side, and a modified earth-filled Ohio River box on the other side. Piers are solid concrete to above the tide level and the beams of the superstructure are to be set on individual pedestals capped with steel plates.

The bridge is a part of a general traffic improvement program which will include a grade separation to carry incoming traffic from Virginia on 14th St., S. W., over traffic from Maine Ave. Contractor is Charles H. Tompkins Co., John A. Scheibel superintendent. The job is by the Public Roads Administration and the Board of Commissioners.

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Hear damage claims in munition truck explosion

A committee appointed by Governor J. M. Broughton of North Carolina has begun hearings at Raleigh on damage claims resulting from the recent explosion of a government munitions truck on a highway near Smithfield, N. C. The explosion occurred when the truck collided with an automobile, and seven persons were killed and considerable property damaged.

The committee, which includes Charles Ross, general counsel for the North Carolina Highway and Public Works Commission, will merely hear claims, forwarding them to North Carolina congressmen. Governor Broughton asserted that such claims are matters for consideration of "the Government or Congress."

Sand and gravel research fellowship available

Applications for the Stanton Walker Fellowship for research on problems related to the sand and gravel industry will be received up to May 1, 1942, on forms available from the Dean of the Graduate School, University of Maryland, College Park, Md. This fellowship, named for the director of engineering of the National Sand and Gravel Association, has been granted once before, for the years 1940-41, when it was held by Fred F. Bartel, a graduate of the University of Wisconsin in 1940, who studied the "durability of concrete as affected by aggregates". Fellows enter upon their duties July 1 at the University of Maryland, and continue for 12 months, with one month vacation. About half the time is spent in class and half in research. Remuneration is $600, and any engineering graduate from an accredited college is eligible.

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New York engineers work on Michigan access road

Engineers from the office of Robert Moses, New York parks commissioner, are cooperating with the Michigan State Highway Department at Lansing in studying plans for construction of the first limited access highway in the state. The New York men act as consultants, studying plans already prepared by department engineers, and offer suggestions as to the design of structures.

Employment of the Moses staff was authorized by the State Administrative Board at the request of G. Donald Kennedy, highway commissioner, who seeks to speed completion of a network of highways around defense plants.

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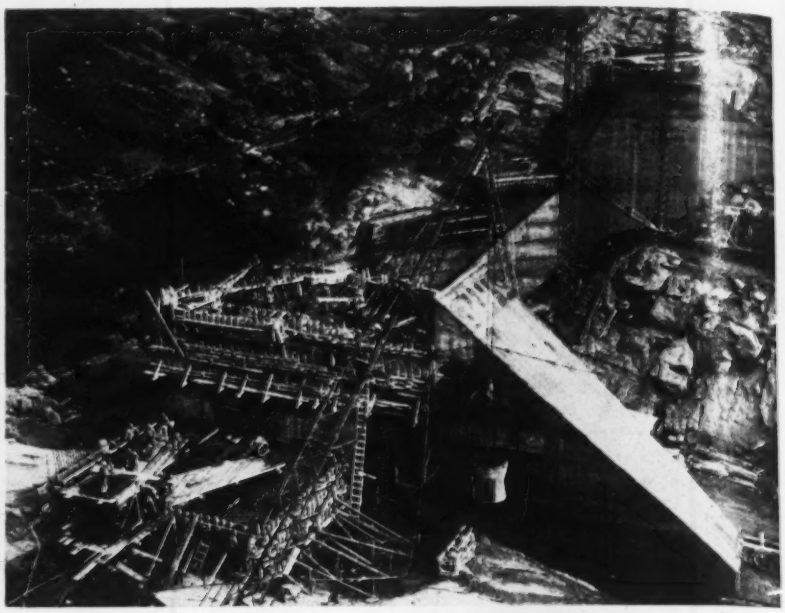
Contractors ask release from road work contracts

The Kansas Contractor's Association last week asked Governor Ratner if it were possible for the state to release contractors from obligations on some of the road jobs in the state, so that their equipment could be used on war work now under way or in prospect.

The governor began a series of conferences on the subject with D. J. Fair, state highway director, and Ross C. Keeling, chief engineer.

J. W. Ballard, secretary of the association, told the governor that the work on various war jobs in the state, would require all of the construction equipment now owned by Kansas contractors.

"If it is necessary," Governor Ratner said, "I feel I must ask the people of Kansas to continue the inconvenience of detours if that will help win the war."



Arch dam built between gravity abutments

A novel feature of the construction project undertaken to supply additional water for Camp San Luis Obispo, Calif., is a 185-ft. high arch dam, which is 600 ft. long on the crest, and built with concrete abutments, placed where they will aid the rock of the Salinas River canyon walls in taking the arch thrust. A portion of the haunch of the arches on either side is anchored into the rock of the canyon walls. To supplement these, abutments of heavy concrete blocks were cast on both banks. This design, of Leeds, Barnard, Hill and Jewett, is somewhat similar to that used by the same engineering firm for the Gibraltar Dam on the Santa Ynez River, built in 1920 to store the water supply of Santa Barbara, Calif. (ENR April 24, 1919, p. 820, and May 20, 1920, p. 1003).

Development of the supply required bringing the water from some other drainage basin. Nearest adequate source was the Salinas River, where, in a narrow canyon, it was possible, by construction of the dam, to develop a storage of 45,000 acre-ft.

From this reservoir, water will be delivered through a 9-mi. pipe line to a 3-mg. equalizing reservoir, whence a pumping plant with a 200-ft. lift discharges into a 8x8-ft. gravity flow tunnel, 5,000 ft. long, extending through the Santa Lucia range. From this tunnel, a 9,000-ft. gravity flow pipeline leads to Chorro reservoir on the military reservation. Construction on the project was begun August 2, 1941, and delivery of water to the camp reservoir was scheduled to start late last month. The cost is estimated at about $3,000,000.

About 45,000 cu. yd. of concrete was used in the dam, mixed in a batching plant equipped with a 2-cu. yd. tilting mixer. Concrete went from the plant to the dam in trucks and a dragline handling a 2-cu. yd. round bottom dump bucket delivered the concrete to place in the center and bottom of the dam. For delivery to the upper parts of the structure, two 15-ton steel derricks with 100 ft. booms were set up on opposite sides of the canyon walls inside the arch.

The contract for the construction of the dam was carried out by the L. E. Dixon Co., Los Angeles.

Steel Institute to honor best 1941 steel bridge

The American Institute of Steel Construction will award a plaque for the most beautiful steel bridge built during 1941, a recent announcement said. Following past practice, designs to be considered will include monumental, medium-sized, short span and movable bridges.

A jury will make selections from photographs submitted to the Institute headquarters at 101 Park Ave., New York. Personnel of the jury, which will include architects and engineers, has not been announced.

Bay bridge re-insurance to be for $33,750,000

Re-insurance of the San Francisco-Oakland Bay Bridge, delayed by considerations of war risks, is approaching consummation, a recent announcement of the California Toll Bridge Authority said.

A statement from the authority said that the bridge will be insured for $33,750,000 as soon as negotiations on the terminology of the policy are completed. The coverage for damage will be the same as has been in effect under the original policies, and will be in accordance with bond indenture requirements.

OBITUARY

Harrison S. Taft, 73, construction engineer identified with naval dock work at Norfolk, Va.; the Grand Central Terminal, New York, and other large projects, died at Providence, R. I., April 3.

Fred A. Lewis, 58, for the past 11 years superintendent of the Billerica, Mass., public works department, died April 4.

Earl H. Flannery, 52, engineer for the Arkansas Highway Commission, died at Little Rock, Ark., April 1.

John Howard Coles, 53, Third Division maintenance engineer for the Tennessee state highway department, died recently at Nashville.

Lawson B. Porter, 34, Newfoundland bridge engineer, died at Fredericton, N. B., March 30.

D. Chester Scull, 72, engineering adviser to the Budd Mfg. Co., died April 1 at Philadelphia.

Robert McDowell, 79, for many years town engineer of Owen Sound, Ont., and for the counties of Grey and Bruce, Ont., died in Toronto March 28.

Arthur Garland Moulton, 66, formerly vice-president of the Thompson-Starrett Co. of New York and Chicago, died March 30 at Chicago. While affiliated with the Thompson-Starrett Co., Mr. Moulton was connected with the construction of Grand Coulee Dam and many other projects.

Frank P. Schade, city engineer of Cudahy, Wis., since 1930, died at a Milwaukee hospital recently. He was 46.

George H. Wallace, an erecting engineer for the Nordberg Mfg. Co., of Milwaukee, died recently at his home in Waukesha, Wis.

John H. Yohe, 82, retired engineer of the Harrisburg, Pa., water department's filter plant, died March 29 in New Bloomfield, Pa.

Edward L. Bock, 69, general superintendent of the western division of the Chesapeake & Ohio Railway Co., died March 30 at Huntington, W. Va. He had been with the railroad for 50 years.

Frank Brink, 74, of Grove City, Ohio, retired deputy county engineer, died March 30 at his home.

CONTRACTS AND CAPITAL

ENGINEERED CONSTRUCTION volume for the week totals $246,344,000, the third highest of the year. It tops last week by 130 percent, and is 77 percent over the corresponding 1941 week. This is the twelfth consecutive weekly total to exceed the $100,000,000-mark.

Public construction is 146 percent higher than a week ago, and 136 percent above a week ago. Private work exceeds the preceeding week by 12½ percent, but is 66 percent lower than in the 1941 week. Federal construction, the primary reason for the public gain, is 154 percent higher than last week, and 196 percent higher than last year.

The current week's volume brings 1942 construction to $2,346,568,000, a 41 percent increase over the corresponding 15-week period last year. Private construction, $213,700,000, is 53 percent below the period last year, but public work, $2,132,868,000, is 75 percent above a year ago as a result of the 130 percent gain in federal work.

New capital for construction purposes for the week totals $17,772,000, a decrease of 84 percent from the volume reported for the week last year. The week's new financing is made up of $10,000,000 in corporate security issues, and $7,772,000 in state and municipal bond sales.

New construction financing for the year to date $2,432,151,000, is up 7 percent compared with the $2,280,741,000 reported for the corresponding 1941 period.

CONTRACTS

(Thousands of dollars)

	Week Ending Apr. 10 1941	Apr. 2 1942	Apr. 9 1942
Federal	$71,237	$83,034	$210,344
State & Municipal	27,588	11,878	22,228
Total public	$98,825	$94,912	$232,572
Total private	40,351	12,224	13,772
TOTALS	$139,176	$107,136	$246,344
Cumulative			
1942	(15 weeks)		$2,346,568
1941	(15 weeks)		$1,669,413

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1941 15 weeks	1942 15 weeks
NON-FEDERAL	$313,856	$207,196
Corp. Securities	101,243	70,810
State & Mun.	173,049	113,072
U.S.H.A. loans	13,521	.....
R.F.C. loans	26,043	23,314
FEDERAL	$1,966,885	$2,224,955
TOTAL CAPITAL	$2,280,741	$2,432,151

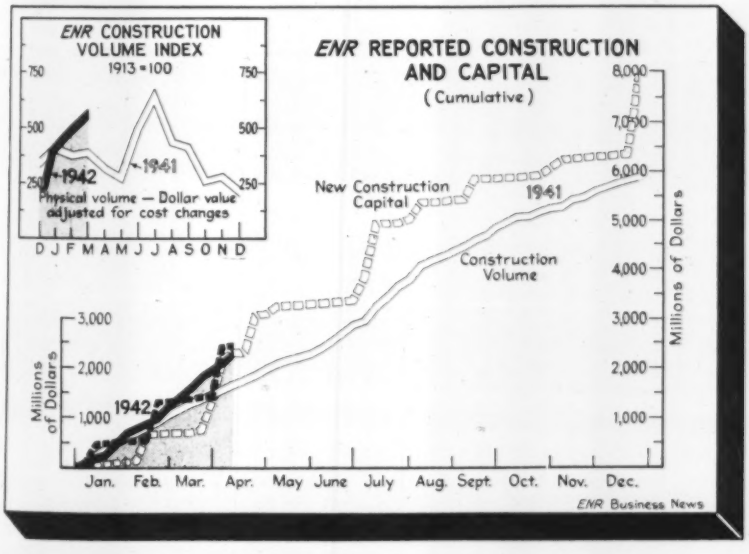
ENR INDEX NUMBERS

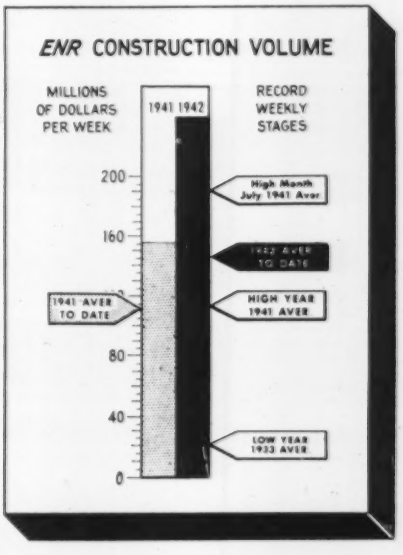
		1913	1926
Index Base = 100			
Construction Cost	Apr. '42	271.78	130.64
Building Cost	Apr. '42	219.55	118.68
Volume	Mar. '42	578	253

FHA MORTGAGES

	Week Ending Apr. 5 1941	Mar. 28 1942	Apr. 4 1942
Selected for appraisal			
Title II	$35,045	$17,613	$18,985*
Title VI		$36,227	$23,103*

* Subject to revision.





Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Igloos and Yet More Igloos

Sir: In the Jan. 8, 1942, issue of *ENR* a picture caption on the Men at Work pages states that Poirier & McLain Corp. of New York City hold the best record ever made on igloo construction, namely 78 igloos completed during a single week and 500 during the period from August 21 to November 13 at the Seneca Ordnance Depot.

We congratulate the above firm on their wonderful record as it is a feat very worthy of the praise given them, especially during the present period of emergency.

In respect to the above being the world's record, however, we wish to draw your attention to the record made by J. A. Terteling & Sons of Boise, Idaho, under Constructing Quartermaster Harry R. Schuppner on the Umatilla Ordnance Depot at Harmiston, Oregon. On this project 24 complete igloos were constructed in one twenty-four hour period, 103 during a single week, and 844 from August 21 to Nov. 5 or eight days less than the time shown at Seneca.

J. A. Terteling & Sons
Contractors
Hermiston, Ore.

Norfolk Housing Troubles

Sir: Builders and developers from all over the nation are writing our committee to find out how many defense homes are needed around Norfolk. Most of them think Norfolk has laid down on the Navy by letting the house shortage grow so acute.

We only promised the government to build 10,000 defense homes and we have completed the 10,000. Now the government has brought in around 100,000 defense workers and the check up shows that we need 40,000 more defense homes and that is why we are inviting out-of-town builders to come and help build the 40,000 homes. The Federal Works Agency is building one-quarter of our needs or about 10,000 units, so that leaves 30,000 more defense homes for private builders and developers.

The six new airports, the Norfolk Navy Yard and the new government-financed shipyards here are spending a half-billion dollars. Besides the thousands of defense workers we have 79,000 men in uniform around Norfolk.

You cannot blame Norfolk for the acute house shortage as our population has jumped from 119,000 to over 230,000, and the government is bringing in around 5,000 more defense workers per month.

W. B. Shafer, Jr.,
Chairman
Emergency Housing Committee
Norfolk, Va.

Engineers Give Kansas City, Mo. Good Municipal Government

Sir: Engineering management has succeeded in Kansas City, Mo., during the past two years, whereas, previously, political management had continuously failed. It will be recalled that in 1940, faced with a serious financial crisis, the voters elected a ticket of non-partisan officials, as a result of which L. P. Cookingham, an engineer, was appointed city manager. He, in turn, appointed Arthur C. Everham, an engineer of broad experience and great administrative ability, to be director of public works, and K. K. King, another engineer of great ability in his field, to head the water department. These three engineers deserve great credit for their contributions to the advancement of the profession in the realm of municipal management and administration.

Upon accepting the directorship of the public works department in June, 1940, Mr. Everham was confronted with a tremendous task. First on the pressing list was a lawsuit by the garbage collection contractor for a bill contracted by a previous administration in the sum of about $230,000, with a threat to stop garbage collections from 80,000 homes and apartments in the city. A very complete engineering survey was started by the director and, with the facts assembled, negotiations were started to open a ten-year contract, with five more years more to run, and an agreement was entered into that resulted in a saving of $130,000 the first year of the revised contract, based on an 11-year average payment of $330,130.

Second on the list was an unpaid bill by the previous administration for power and street lighting. The same procedure was followed as in the garbage case and, with well prepared engineering reports, Mr. Everham again effected a saving of about $135,000 a year for the city.

New trafficways were started and are well advanced, as are rebuilding and resurfacing of miles of neglected streets, construction of miles of sewers and development of the municipal airport. Ground has also been purchased for an upland airport, and it is now being designed, with some $1,500,000 provided for start of construction.

Payrolls have been cut at least one-third, and work carried on by the department was increased despite the fact that excess labor was removed.

I have only listed the important items and, with engineering studies now well advanced, many projects will be underway when war activities cease to take materials.

In the water department, Mr. King, the first engineer ever to head it, has made an equally good record. This department showed a deficit in 1938–39 of $78,315 and in the 1940–41 period a saving of $436,350; an even larger saving will be made this fiscal year. A water-softening plant, costing over $500,000, is nearing completion and is paid for from savings made largely by reducing the number of employees from 862 to 450 and stopping money leaks in addition to water leaks.

William H. Smith
Consulting Engineer
Kansas City, Mo.

[It is significant to add that on March 31 the Kansas City voters returned the above administration to office for two more years.—Editors.]

Origin of the Beehive

Sir: Lest an injustice be done, I hasten to make a correction to the article by our chief engineer, Francis R. MacLeay, on the subject of "Concrete Beehive for Munitions Storage" (*ENR*, March 26, 1942, p. 498).

Credit must be given to Lt. Col. B. F. Vandervoort, Corps of Engineers, U. S. Army, who induced the writer to investigate the construction

merits of the dome-shaped beehive finally designed.

Since most of the savings realized are inherent in the very shape visualized by Lt. Col. Vandervoort, it is patent that credit for originating the beehive must be chalked up to him, rather than to anyone else.

LOUIS P. CORBETTA
Secretary
Corbetta Construction Co.
New York

Glenville Dam Is Rockfill

Sir: Referring to the article describing the Glenville Hydro-Electric development (*ENR*, Feb. 26, 1942, p. 334), I note that the drainage area is given as 29.4 square miles. This should be 39.4 square miles. I also note that the Glenville dam is described as earthfill encased in rock. This is incorrect, as it is fundamentally a rockfill dam with an impervious earthfill blanket on the upper side. In the case of the Glenville dam the dimensions of the downstream rock section have been reduced, and the dimensions of the upstream impervious or rolled-fill section have been increased to correspond with the quantities of material which were excavated from the spillway and foundation. This change in the relative amounts of rock and earth does not change the essential characteristics of the dam.

J. P. GROWDON
Chief Hydraulic Engineer
Aluminum Company of America
Pittsburgh, Pa.

Restrained Cable Bridge

Sir: The cumulative aerodynamic oscillations of the cables of the Tacoma Bridge disclose a deficiency in usual theory and design of light, long-span suspension bridge structures. However, a study of the horizontal and vertical components of cable distortion suggested to the writer that forces might be introduced to fix cable curvature and thus make suspension bridges comparable to the cantilever type in point of stiffness under load and wind action.

The accompanying illustration shows what the writer has called a restrained-cable structure. The dotted line above the cable is the equilibrium polygon of the cable under uniform loading. From this position the curvature is sharpened through screw adjustment of the ties, and the cable is thus drawn down to the full line shown in the drawing. The lower ends of these ties are attached to a box strut, extending from tower to tower and clamped to the cable at midspan. Sliding supports at the towers, resisting both upward pull and downward pressure, are provided for this strut.

In distorting the natural curve of the cable and sharpening the curvature next to the tower, the secant of the angle of the inclination of the cable, which determines the stress therein from the load reaction, is reduced; hence, the cable when distorted can support a greater load without increase of section. The vertical components of the ties constitute these virtual additional loadings and, while they do not increase the maximum stress in the cable, they do increase what would be the minimum stress at the center of the span.

The automatic counterbalance of the arrangement is of interest. If the initial stress in the ties on the loaded half of the span is reduced 80 to 90 percent by the partial loading, the strain in the ties on the unloaded half is increased by substantially the same amount. In other words, the sum of the vertical components of the tie-

Proposed restrained-cable type of suspension bridge.

stays is a constant, though forming an automatic counterbalance for unsymmetrical loading through the flexibility of the cable. The action is novel and different from any which the writer has hitherto considered or seen described.

In operation of the system, a load approaching from the right reduces the initial stress on the ties in the right half of the span and increases the tension in the ties on the left half of the span. This arrangement, with proper takeup on the ties, is statically determinate. The reactions at the tower are determined as with a simple span. The pole distance is the horizontal stress on the cable at midspan from which the strain on the ties is found graphically.

With rise in temperature the cable expands and would tend to slack the stress on the ties were it not for the expansion of the strut from midspan toward the towers, maintaining substantially constant tension on the ties under uniform load.

The curvature of the cable is substantially fixed because its variation in form is limited by the elastic strain on the ties. This is negligible compared to the horizontal and vertical components of the galloping oscillations developed at Tacoma.

From an economic standpoint, the cost of the restraining means is but a fraction of the cost of stiffening trusses. The stiffening truss and cables of customary design operate as an aggregation lacking in combined action to prevent cumulative oscillations. In the proposed type the ties and strut, in combination with cable distortion and restraint, render cumulative oscillations impossible, whether from live loads or aerodynamic forces.

C. A. P. TURNER
Consulting Engineer
Columbus, Ohio

Timber Bridges

Sir: In view of the present situation created by the war, which situation will probably get considerably worse before it gets better, the article on "Timber Bridges" by W. C. Hopkins (*ENR*, Feb. 12, 1942, p. 279) was very timely and interesting. For some time bridge construction will probably be greatly curtailed, and small structures, which would have been constructed of steel or reinforced concrete, will either not be built at all or will have to be built of timber.

Referring to the composition deck mentioned by Mr. Hopkins, the writer wishes to call attention to a somewhat similar type of construction used by the State of Oregon. This consists of a concrete deck slab supported by and shear connected to timber stringers so as to act as "T" beams. This deck is supported on timber-capped pile bents similar to the Maryland construction. This type of construction is very fully covered in a bulletin by the Oregon State Highway Commission, Technical Bulletin No. 1 by R. H. Baldock and C. B. McCullough (see also *ENR*, Aug. 25, 1932, p. 214 and Oct. 4, 1934, p. 420).

In cases where longer spans than could be built by Mr. Hopkins' construction were required this composite "T" beam type might be just the thing to solve the problem.

KARL W. LEMCKE
Waddell & Hardesty
Consulting Engineers
New York, N. Y.

EDITORIALS

VOLUME 128 NUMBER 15

April 9, 1942

Arthur N. Talbot

THE CIVIL ENGINEERING PROFESSION lost a rare figure last week with the passing of Arthur N. Talbot, professor emeritus of the college of engineering at the University of Illinois. A few other engineers have attained greater fame or wider public recognition, but none has ever stood higher in the esteem of all those with whom he came in contact in the course of his daily tasks. Engineering ability of a high order in Dr. Talbot was supplemented by a kindly wit and a lovable personality. His contribution to the advancement of engineering knowledge was very large, and much of it was of a fundamental nature, such as his work on railroad track stresses. But it will be Arthur N. Talbot, the man, who will be remembered and whose life will reflect the greatest honor on his profession, not Arthur N. Talbot, the searcher after new scientific truths. There is in his life a lesson for every engineer.

Fires in Wartime

A FRIGHTENING BOOK of pictures has just been published by the National Fire Protection Association. It is frightening because we set the fires ourselves by carelessness or disregard for prudent practices. And it is frightening because of the damage that each fire did to our war effort. No caption is required to a picture showing the great liner "Normandie" lying on her side in the Hudson River; to another showing 14,000 tons of rubber going up in the smoke of a Fall River factory; to a third showing a building under construction at the Springfield Arsenal enveloped in flames; to a fourth showing a fire consuming 10,000 tons of cork in Baltimore; or to a fifth showing the twisted remains of an aluminum casting plant in Cleveland. Each fire spells a defeat for us and a victory for our enemies. And each one that could have been averted by slight changes in design or less careless building is doubly tragic. Many useful design expedients are so simple that it is almost criminal to neglect them; for example, dividing large structures into small units by fire partitions; limiting the upward travel of fire, smoke and gases by enclosing elevator and stair shafts in fire-resistive materials; isolating hazardous processes in separate fireproof buildings; and installing automatic sprinklers. Likewise, a minimum of difficulty is entailed in avoiding such dangerous construction practices as permitting debris to collect on floors of buildings under construction; leaving burning salamanders unattended; or storing paint or combustible supplies where they can burn unnoticed for even a minute or two. Reducing the number of wartime fires will contribute directly to winning the war.

Meeting the Exigencies of War

INGENUITY is the most important tool in the kit of engineers today. Working in an economy turned topsy-turvy by war production, the engineer is forced to provide unconventional solutions for otherwise normal problems. Illustrating this is an article on p. 76, describing the design of water supply and sewage disposal facilities for small communities that suddenly tripled in size. Ordinarily, such a situation poses no great problem. But things are different today. First, a number of substitutions were called for to conserve critical materials. Then followed a major departure from conventional water distribution practice in utilizing a pumping arrangement that obviated the need for elevated storage—this because of the lack of steel tank plate. And finally, in the design of sewage disposal facilities, provision had to be made for economical conversion to post-war needs that will be only half as great as present requirements. Here is a prime example of readjustment in thinking caused by the exigencies of war.

Mobilize Engineers

ONE HUNDRED PERCENT mobilization of engineering and scientific skill, as has been undertaken in Canada to advance the war effort (*ENR* April 2, p. 511), should be inaugurated here at the earliest possible moment. Such a step would be but a logical sequel to selective service, which in a few weeks will have registered all the nation's manpower between 18 and 65. The Selective Service Act took military service out of the hit-or-miss voluntary class and put it on a logical and equitable basis; mobilization of engineering skills would put at the disposal of the government a vast reservoir of engineering ability that until now has been largely untapped except as the individual engineer volunteered his services. The groundwork for such a mobilization was laid by the engineering societies months ago when they tabulated the experience

records of their members for use of the government: but that was all done on a voluntary basis and the lists now are largely out of date. If similar registrations were now made obligatory for all engineers, records would be put in the hands of the War Production Board which would make it possible to find several candidates for every job for which the government or any one of the war industries may seek men of special skill. From these candidates, those in positions having little or no bearing on the war effort could be canvassed quickly to determine their availability. Much of the work of classifying engineers and keeping their records up to date could be done by the engineering societies themselves as their contribution to the war effort. Here again, Canada has shown the way, the Engineering Institute and the provincial engineering associations having been instrumental last year in setting up the Wartime Bureau of Technical Personnel in the Department of Labour.

Water Service—How Important?

SHOCKING AS IT MAY SEEM, at least one high-ranking state civilian defense official recently admitted that he never thought water supply was important until it was brought to his attention by the fall of Hongkong and Singapore. If our leaders in air-raid precaution measures have harbored such misconceptions, what must be the attitude of the average citizen in regard to water service? Quite logically it may be concluded that the general public is blithely unaware of water "until the well runs dry."

But if the well runs dry during the emergencies for which we are now preparing, there is going to be hell to pay—and every waterworks man knows it. Yet, in all of these months of strenuous preparation to strengthen water supply systems to meet the extra demands created by industrial expansion and emergency conditions, the facts would indicate that few outside of the waterworks field itself have attached much importance to this vital utility.

For example, it was only recently that one state found it desirable to urge the appointment of a waterworks department representative at the air-raid control centers in each municipality. A further indication that the complexity and importance of water-system operation is under-estimated is revealed by the requests of air-raid wardens to be supplied with hydrant keys and distribution maps showing valve locations. The folly of having anyone but a qualified waterworks man undertake such operations is too apparent for comment.

All of which leads to the suggestion that some strong public relations efforts are badly needed—not to "sell" waterworks service, but to prevent disaster.

Right Behind the Marines

IN ITS PLAN TO ENLIST and train special construction battalions in the Bureau of Yards and Docks, as announced last week, the Navy Department follows a course made inevitable by modern war. For if we are to "seek out and engage the enemy wherever he may be," as the President has promised, the Navy must have bases all over the world. No longer can ships come to home ports for repair. No longer can all of the navy planes in a combat zone be housed on carriers. No longer, indeed, can casualties be brought to base hospitals in the United States or its possessions. Naval bases, airbases, hospital units must be strung "from the halls of Montezuma to the shores of Tripoli," and then some.

Nor, once established, are these facilities fixed in location, for as the theater of war changes so must the shore establishments that service the fleet and the air arm shift with it. For such work the Navy needs enlisted construction forces, just as for similar work the Army has long had its engineer regiments. The Corps of Engineers, like the Bureau of Yards and Docks, has followed a policy of using civilian contract construction for its large and permanent installations, but when work is required in combat zones the Corps has had to rely on its troops. Now that part of the Bureau's job is shifted to the front lines it is to do likewise.

It is pointed out that the Navy's construction battalions (C.B's), or "Seabees" as they have been nicknamed, are not supposed to fight. Neither were some of the engineer regiments sent to France in 1917, yet they fashioned for themselves an enviable reputation for valor in battle. Without question the Seabees will do the same, for in the normal course of events they will be right behind the Marines. Led by such capable officers and construction men as are to be found in the Bureau of Yards and Docks, the Seabees are certain to make a name for themselves. A new Navy and American tradition is in the making.

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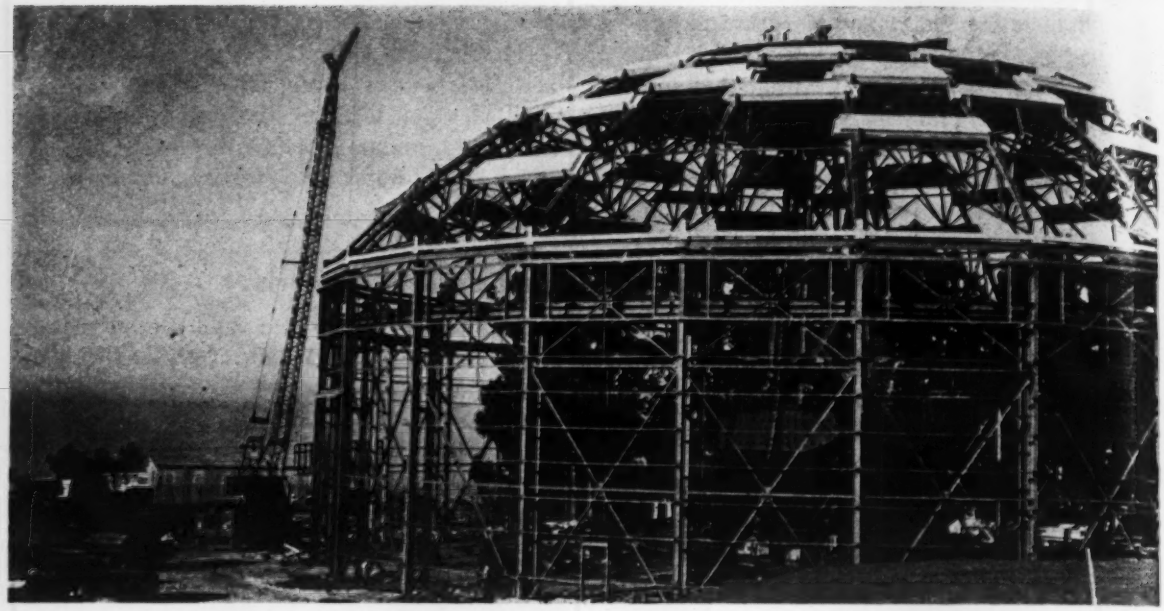


Fig. 1. Pre-cut sheathing for dome is being lifted to place by a long-boom traveling crane. The dome is 160 ft. in diameter.

Domed Building Fitted to Research Needs

***Contents in Brief**—The structure to house the 100,000,000-volt cyclotron at the University of California has been designed to meet unusual requirements; interior columns are eliminated by a domed roof on stiffened ribs, stresses in the ribs are reduced by a polygonal steel tie at the spring line; and a nearly circular plan makes it possible to use an overhead crane that rotates about a center. The total weight of roof steel is 11 lb. per sq. ft.*

THE DESIGN of a suitable structure for housing the hundred million-volt cyclotron, now under construction at the University of California, involved considerable pioneer work, not only because of the unusual shape and size of the structure but because there was no advance knowledge of just how requirements may change as research progresses with this unusual piece of apparatus. Obsolescence might even affect the usefulness of the structure for this particular purpose in a relatively short time. It was therefore desirable to avoid any unnecessary expense in the structure itself and to use materials with a maximum salvage value. Beginning with the idea of a building octagonal in plan, numerous variations were studied until a satisfactory solution was found in the interesting dome type structure here described.

The original plan was to put the building underground. The program at that time was to divert a stream from one of the deep, narrow canyons near the campus, and excavate in the streambed a subterranean vault in which the cyclotron structure could be buried under a 15-ft. layer of earth as a shield for emanating rays. Preliminary design and cost estimates were prepared for a concrete structure with a dome roof satisfying these conditions.

Isolated site chosen

Later, the decision was reached to obtain the necessary isolation by locating the building on the shoulder of a remote, high hill where the desired encircling clearance was available. Control rooms for the operators are to be located beyond the brow of the hill, thus interposing an earth shield or screen between them and the cyclotron.

The objection to a rectangular building was that clear floor space is needed for 80 ft. radially from the center of the cyclotron and all of this space is required to be under a crane of 30-ton capacity. These requirements are most satisfactorily met by the 24-sided building. As all of the sides of such a building are equidistant from the cyclotron, it will be easy to add the wings that may later have to be located along radial lines extending from the central atom-smashing instrument.

The inner end of the overhead crane bridge pivots around a support on top of the cyclotron itself, while the outer end travels on a circular track, attached to box girders supported on the wall columns. The tractive forces exerted on the track are carried down to the foundation through bracing in the walls. Radial forces at the center are resisted by the cyclotron itself.

First designs, to which consideration was given but which were later abandoned, were for a framed steel dome with shallow meridian ribs (10 in. deep), horizontal rings and diagonal rods. In this type of framing all loads are assumed to be concentrated at the panel points, where they are statically balanced by stresses in adjacent ribs and rings. Complications are experienced, however, by the un-

symmetrical loading due to wind pressure and suction, and to the requirement in this instance that the roof must be able to carry concentrated loads from apparatus that might be suspended anywhere. In addition, it was decided that this design would not be quite as stiff, and its erection would be somewhat difficult and more expensive than the design later developed.

Spider-web roof design

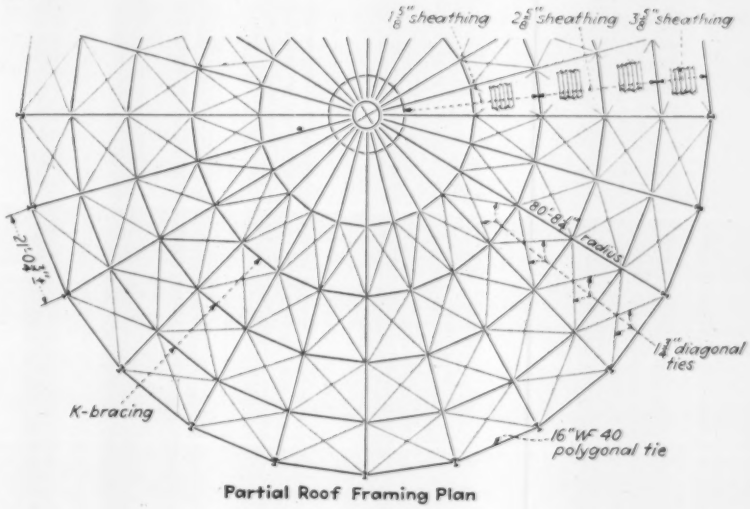
The roof framing finally chosen consists of 24 steel ribs or trusses, all connected to a drum at the center, or crown of the dome and tied together at the spring line by a polygonal steel tie. The lower end of each truss is carried by a wall column. The dome is therefore virtually an aggregation of crescent trusses with the drum at the crown forming their common connection. Horizontal movement at the bottom is restrained by the steel tie, a 16 WF40 beam placed with the web horizontal. Elongation of this beam under load is taken into account in the design. This tie greatly reduces the stresses in the truss members as compared to what they would be in a simple truss. The average reduction is 55 percent for the top chord, 88 percent for the bottom chord, and 68 percent for web members. For a very little extra expense the members in the trusses were chosen so as to be able to carry the dead load without the aid of the steel tie. Due to radial spacing of trusses the loading is variable, being maximum at the support and minimum at the crown. The resulting bending moments are less than for uniform loading.

Roof bracing and sheathing

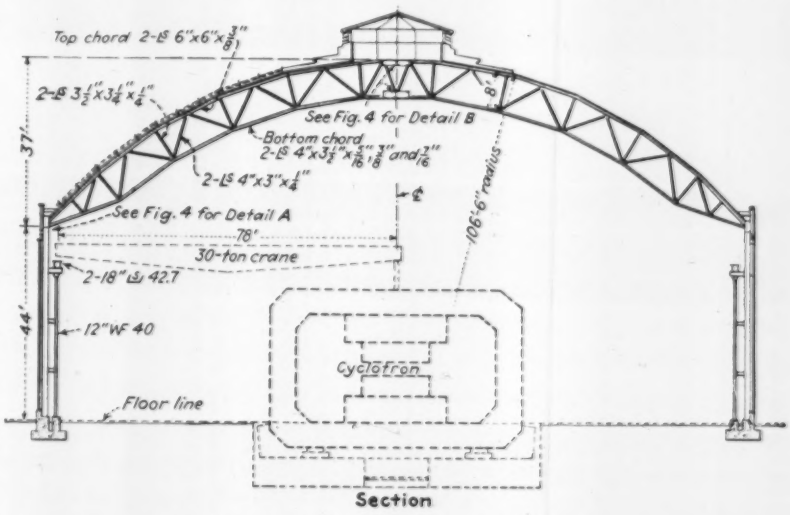
The chords of the dome ribs or roof trusses are on straight lines for two panel lengths; that is, slope changes occur at every other panel point. At these alternate panel points, lines of light K-trusses encircle the roof, and between them 1¼-in. round, diagonal rods in both directions are introduced. Their function is to resist lateral forces and to distribute unsymmetrical loading. The tierods were provided with turnbuckles and were brought up into initial tension after the trusses had deflected under full dead load.

As the trusses are 21 ft. apart at the spring line, and this spacing rapidly decreases toward the crown, it

Fig. 2. The dome ribs, starting from tension ring at spring line, meet in a common center at the top. Note diagonal tierods and transverse K-bracing at panel points. A timber frame, supporting the ribs during erection, stands on the steel magnet at the left.



Partial Roof Framing Plan



Section

Fig. 3. Connections at crown, at spring line and other details for the steel-frame dome.

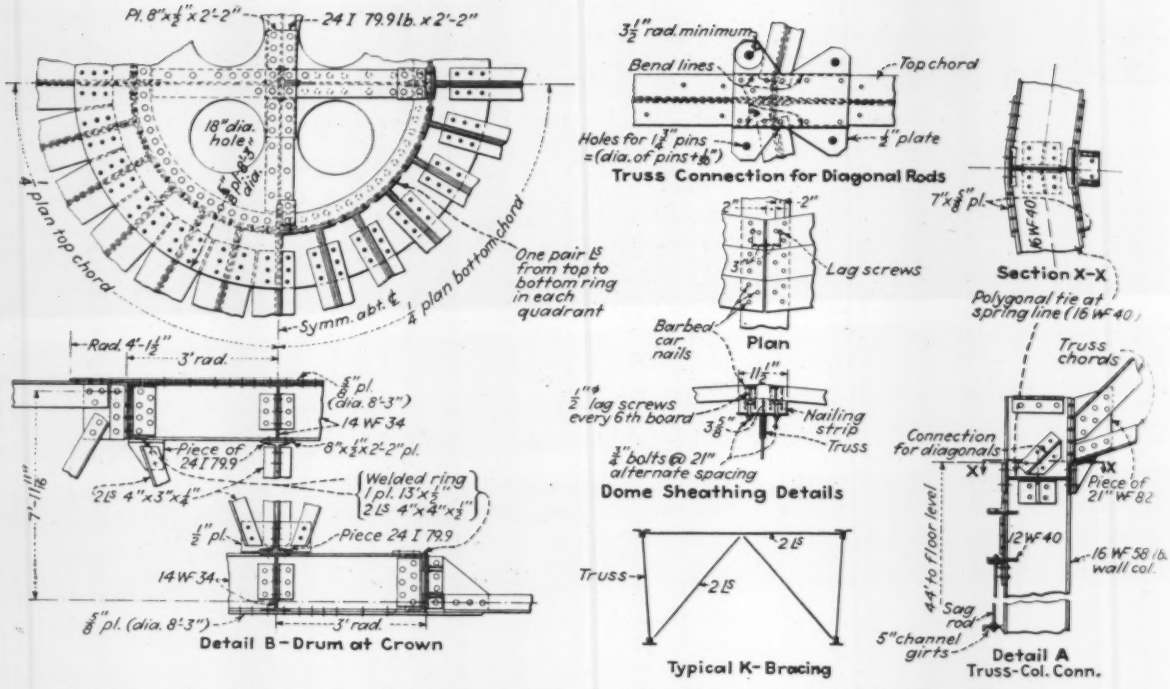


Fig. 4. Plan and section show principal structural features of the steel framework for the 160-ft. diameter dome.

was possible to do away with purlins and to use sheathing that spans from truss to truss. Near the base, for the longer spans, sheathing with a nominal thickness of 4 in. was used. As the spans decreased toward the crown, 3 in. and later 2-in. thicknesses of sheathing were used.

The sheathing is attached to wood nailing strips fastened to the trusses. These strips were bolted in place before the trusses were erected—a program that was facilitated by making templates in the steel shop, where the trusses were fabricated, and using them for pre-cutting and boring the nailing strips. The strips were ready then when the trusses arrived on the job. To assure good resistance to an uplift, barbed car nails were used for nailing the sheathing to the wood strips and lag screws were also added at intervals. Composition shingles were laid over the sheathing to complete the roof.

The building was designed for a roof live load of 20 lb. per sq.ft. on the horizontal projection of the roof surface, and for a horizontal wind pressure of 20 lb. per sq.ft. on the windward side and equal suction on the lee side. The wall siding is a corrugated asbestos composition, attached to 5-in. channel girts spanning between wall columns.

Despite the dome roof and near-circular plan of the building, all frame members are straight, standard shapes. The only curved steel in the structure is the drum at the crown. The total weight of roof steel is 13 lb. per sq.ft. of horizontal projection, or 11 lb. per sq.ft. of roof surface. This weight includes main trusses, steel drum, steel tie ring at the base of the dome, K-bracing and diagonal rods.

Cost of the building itself was $106,000, which is only about 7 percent of the total cost of the cyclotron project. Dr. E. O. Lawrence, director of the radiation laboratory, University of California, is in charge of the project.

The general contract for construction is held by Frank G. Lynn, Oakland; steel fabrication and erection was done by the Moore Dry Dock Co., Oakland; Arthur Brown, Jr., is the architect; structural analysis and plans were prepared by Hall & Pregnoff, structural engineers, San Francisco.

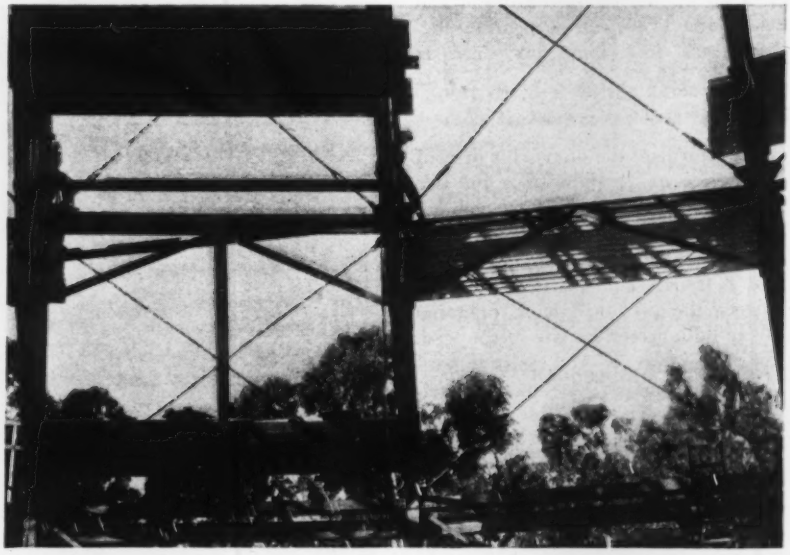


Fig. 5. Workmen placing sheathing, which is supported directly on the roof trusses, without the aid of purlins.

Pipe Drains Stop An Earth Slide

DRAINAGE of a troublesome earth slide at St. Mary's playground in San Francisco has been accomplished by a novel method of putting down vertical holes, 30 in. in dia. and 5 ft. center to center, from the bottom of which perforated drainpipes have been placed below the original ground and rock line. Backfilling around the drains with crushed rock is expected to maintain a permanent means of escape for the groundwater that has caused the slippage, thus permanently stabilizing the overlying material.

St. Mary's playground is located on a benched area formed some six or seven years ago by the cut-and-fill process. The fill consisted of loose material dumped from wheelbarrows and left to settle as it would. Some four years ago, earth movement started and large sections of the fill (areas of 2,000 sq. ft. or more) slid out, apparently as the result of hydrostatic uplift. Instability of the area continued, and when it appeared that 15,000 sq. ft. of playground area was being lost, special attention was given to finding means of stopping the movement.

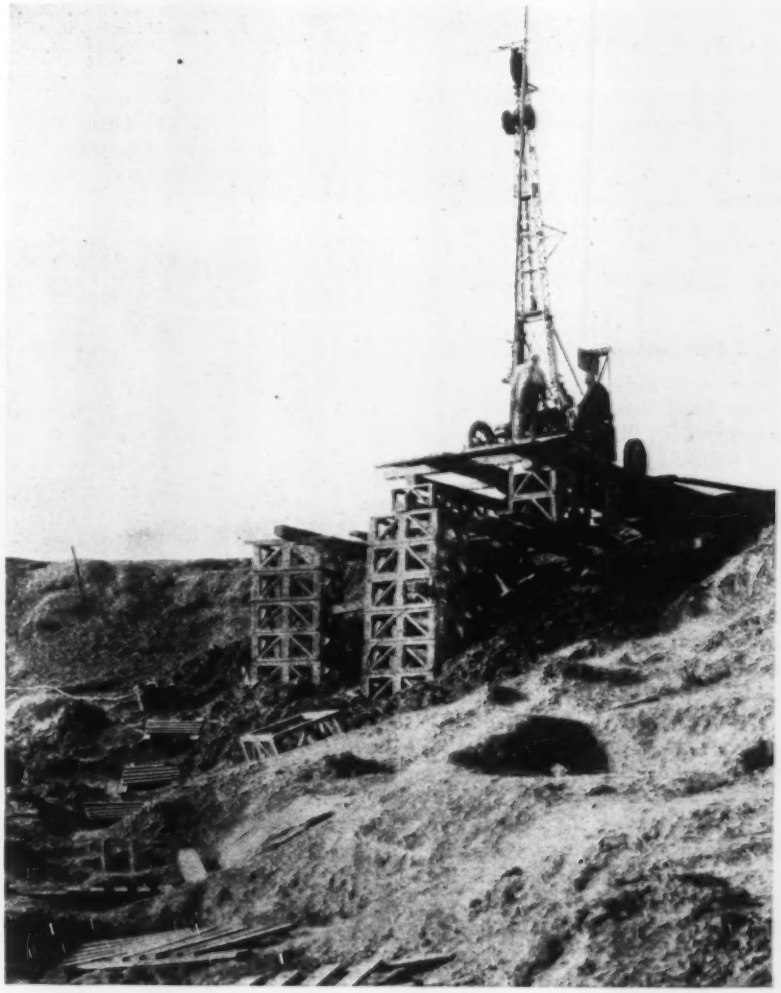
Subsurface seepage course plotted

A contour map was available showing the old ground surface before the fill was made. Borings showed the fill to have become practically impervious, and water under pressure was found in the disintegrated rock below the original ground surface. The probable course of subsurface seepage was plotted and a plan was worked out for laying perforated drainpipe in this disintegrated rock above the sound rock, without tunneling or open trench excavation. The latter would have meant depths of almost 40 ft. Furthermore, the depth of sound rock below the original soil surface was found to vary greatly from place to place. Hence, in order to secure the necessary grades, the corrective work had to be carried on as a combination of exploration and drainage construction.

The plan of operation was to put down bored holes 30 in. in dia. to a depth 2 to 4 ft. below rock surface. By spacing these holes on 5-ft. centers, it was possible to punch an opening from the bottom of one hole through to the next to drain each in turn. These openings were enlarged to about 1 ft. in dia. so that 6-in. drainpipe could be laid therein. The slope of the drainpipe was maintained fairly uniform by varying the alignment of the holes to fit the sound rock contour. The drainpipes usually could be laid with the lower half imbedded in fairly sound serpentine.

The location for each new hole to be put down by the drill rig was selected in the light of: (a) conditions found at the bottom of the preceding hole; and (b) prediction of nearby sound rock contour. Although somewhat irregular, the route followed was such as would collect the water flowing underground and thus it accomplished the objective of leading it off to one side near the upper edge of the slide area.

After an opening had been made to connect the bottoms of adjacent drillholes, a groove about half the diameter of the 6-in. pipe was cut in the serpentine. Alongside this groove the surface of the cut was left sloping toward the groove to facilitate ac-



Drill rig that bored 30 in. dia. holes down to sound, dry rock, a maximum depth of 37 ft. Drains were laid to connect the bottoms of these drillholes.

cess of drainage water. The drain used was 10-gage well casing in 3-ft. lengths, perforated in the upper half of its circumference by machine-cut slots ¼x1½ in. in size.

After these pipes were in place so that drainage was established from one vertical hole to the next, crushed-rock backfill was tamped into place around the pipe and was carried up in the vertical holes to a depth of 3 to 6 ft. above the drainpipe. Every tenth hole was filled with crushed rock to within 3 ft. of the surface. Before completing the backfilling of the holes, a 2-in. layer of straw or a burlap covering was placed on top of the crushed rock to prevent clogging with earth.

The drilling operations were started at the edge of the slide where an exploration trench revealed a contact between a siliceous rock and serpentine to exist under the fill and a "gully" in the rock surface, not evidenced by the ground surface contours, through which seepage passed the toe of the fill. From this point, the drillholes were located diagonally upward across the slide through the serpentine area to and along another contact "gully" (in which much subflow was concentrated) over the crest of the old fill, and into the level bench made for the playground surface beyond. About 120 holes were put down.

Seepage water tapped

As soon as the work was well underway, accretions in the water flow gave assurance that the seepage was being tapped and there was proof of the effectiveness of the remedy as operations proceeded, especially after the winter rains set in. When the drill rig reached a point near the upper end of the line of holes and the depths decreased to about 6 ft., drilling operations were stopped and from there on to the upper end of the drain line, the pipes were laid in open trench. Corrugated iron pipe, also perforated in the upper half, was used in the trench.

To facilitate delivery of crushed rock to drillholes on the face of the steep slide, a wooden chute was used, leading down from the bench above, into which the material could be dumped. Location of the holes is indicated in the accompanying picture by the coverings of boards put over the top of each hole as a safety precaution for the workmen.

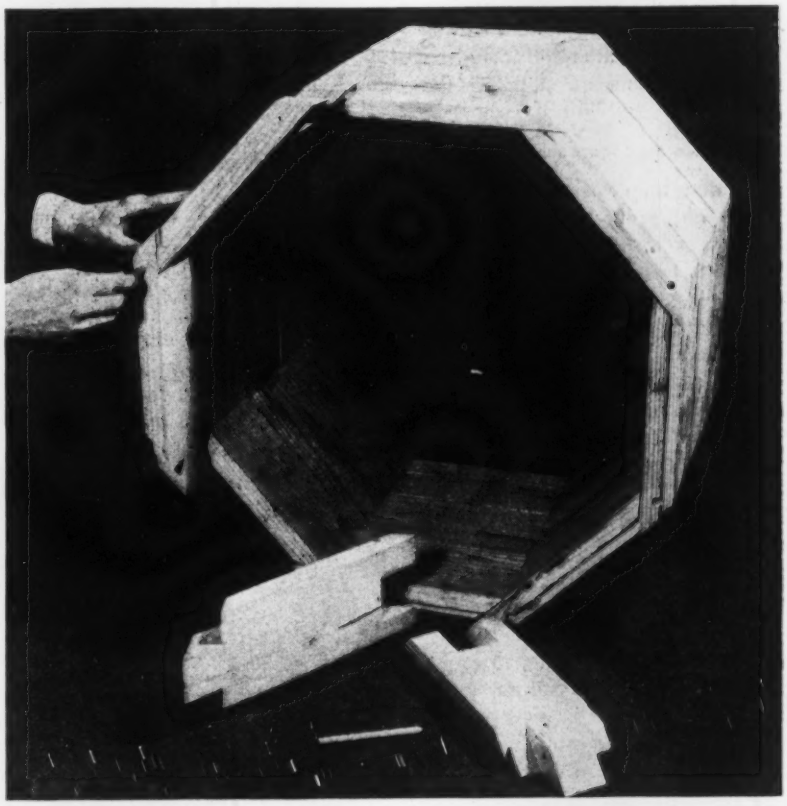
This drainage program will be completed at a cost to the city of about $18,000, according to a plan worked out and supervised by Hyde Forbes, San Francisco, consulting engineering geologist. George F. Harman is engineer for the San Francisco recreation commission for whom the work is being done under contract to I. P. Tikiob.

Armco Designs Wood Culvert To Conserve Critical Material

LONG IDENTIFIED with the field of drainage through development and promotion of corrugated metal pipe and culverts, the Armco Drainage Products Association, Middletown, Ohio, has now designed a sectional wooden culvert in the interests of conservation of sheet metal. Corrugated metal pipe can still be obtained for use on war projects where no suitable substitute may be used, but substitutes must be used on other locations.

After considerable experimenting the Armco organization developed a sectional octagonal-shaped wood pipe, fabricated from various sizes of lumber according to load requirements, and fastened together with wood dowels, eliminating all metal. Units are shop-assembled into lengths of 12 ft. or more, which are joined together in the field into a single structure. Ordinary wooden box culverts are rigid, but this new segmental design results in a flexible structure that builds up side support with resulting increase in load-bearing capacity. Thickness of the wood segments can be varied with the diameter of the pipe. The segments can be rapidly cut in any job carpenter shop. Scrap lumber may be used if desired, and the ultimate life may be increased by treating the wood.

The Association has prepared a four-page folder describing the design, obtainable at the Middletown headquarters or from any of its member companies.



Sectional wood pipe culvert designed by Armco as a substitute for metal pipe made scarce by the war emergency.

Flight Strip Plans Take Definite Form

***Contents in Brief**—Construction of flight strips adjacent to public highways, as an aid to the air forces of the nation, was authorized by the Defense Highway Act in 1941. Plans for selection of sites and construction of the flight strips have been perfected and the first work soon will be underway. Minimum requirements, as prescribed by the U. S. Army Air Forces, are given.*

CONSTRUCTION of the flight strips authorized by Congress under the Defense Highway Act of 1941 will be underway within the next few weeks. Location of these auxiliary landing areas is not being made public for obvious reasons, and like restrictions will surround the location of other sites as the program develops. However, information as to the basic requirements and as to the methods to be employed in the selection and construction of flight strips is available. The most complete information to be made public on this subject was given in a talk made recently before the Association of State Highway Officials of the North Atlantic States by Lt. Col. Stedman Shumway Hanks of the U. S. Army Air Forces.

Location of flight strips

Flight strips are simply areas for the landing and take-off of aircraft and, contrary to common belief, they are not to be built *parallel* to highways unless the character of the terrain makes that possible. They are, however, to be built adjacent to highways, primarily to facilitate access to the flight strips for maintenance and to service planes when the flight strip is in use.

The Defense Highway Act of 1941 authorizes an initial appropriation of $10,000,000 for the flight-strip program, and $5,000,000 was appropriated by Congress in the Third Supplementary National Defense Act, approved Dec. 17. On Jan. 9, representatives of the Army Air Forces, the Public Roads Administration and the American Association of State Highway Officials met to formulate general plans for the program, and about Jan. 24 instructions regarding the location and development of flight strips were sent to the commanding generals of the four Air Forces in this country.

At that time, initial allotment of $2,000,000 for the construction of flight strips was made to district engineer of the Public Roads Administration in each of the four air-force areas into which this country has been divided and the air-force engineer in each of these areas was instructed to work with the district engineer in selection of sites and in determination of priorities of construction to the extent that funds are available. Reports showing sites approved and recommendations for additional flight strips are submitted through proper channels to the authorities in Washington so that the work in the several air-force areas and in the PRA districts can be properly coordinated.

At the present time the preliminary layout plans for each flight strip normally will be prepared in the PRA district office, and that office will be in charge of the project in accordance with specifications made available to the Commissioner of Public Roads by the Army Air Forces. Actual construction operations, in most instances, probably will be carried out by the state highway departments.

Minimum requirements

The minimum flight-strip requirement is an area that will permit the construction of a single runway not less than 150 ft. wide and 3,000 ft. long for pursuit aircraft, and not less than 4,000 ft. for all other military aircraft. These lengths are for flight strips at sea level, somewhat longer runways being required at high altitudes (*ENR*, July 4, 1940, p. 14). The ideal would be a flight-strip area 1,800-ft. wide and 8,000-ft long, but flight strips 1,000-ft. wide and 5,000-ft. long can be used.

Wherever possible, runways are to be laid out in the direction of the prevailing winds and so placed that at least one point is in contact with a serviceable highway. The characteristics of the surrounding terrain may be uneven, but the runway itself should be smooth, with a grade of not over 1 percent for the entire usable area. The surface of the runway, whether paved or sodded, should have adequate bearing characteristics, some form of stabilization being applied if necessary.

Surface loads

Surface loads to be taken care of will depend upon the use to which the runways are to be put. The heaviest load anticipated for some time to come will be that produced by the heavy bombardment planes, which call for static wheel loads of 60,000 lb., tire inflations of 70 lb., impact factors of 25 percent, which with a minimum safety factor of 1.20 produce a load of 583 lb. per sq.in.

The safe glide path outside the flight-strip area on a prolongation of the runway should be, wherever possible, within a trapezoidal area two miles long extending beyond the boundaries of the flight strip area in the direction of the center line of the runway. This trapezoidal area should be not less than 300-ft. wide at the boundary of the flight strip (1,000 ft. wide for instrument landing) and 4,000 ft. wide at the far limits. Within this trapezoidal area no obstacles should be permitted of sufficient height to obstruct an angle of glide of 40 ft. horizontal to 1 ft. vertical. In some locations, a glide angle of 30 to 1 may have to be accepted. Public utility pole lines on the near side of the highway right-of-way or at the end of a runway should be moved or placed underground.

Number required

The number of flight strips required in any one area will be determined by the Army Air Forces. In general, present plans call for the construction of a large number of flight strips to provide many points for the dispersal of aircraft, for training and for tactical use. The ideal would be the provision of four such strips for each fighter, interceptor or bombardment group in service in any area.

General view of welding shop and yard at Coram, a mile from the dam, the nearest point at which reasonably level ground of adequate area could be found. Stress-relieving furnace stands to one side at the rear end of the shop.

Welding and Testing Shasta Penstocks

G. L. Yetter
Engineer
U. S. Bureau of Reclamation, Redding, Calif.

***Contents in Brief**—The main-unit penstock systems at Shasta Dam consist of five all-welded pipes 15 ft. in dia. with branches to station service units. The field fabricating plant, one mile from the dam, is equipped with an alternating-current, automatic arc welding outfit which completes welds of all plate-metal thicknesses (¾ to 2½ in.) in only two passes, using a special flux to exclude atmospheric contaminations of the welds. Portable, shielded-arc welding sets are used for welding field seams after the penstock sections are in place on the dam.*

THE FIVE MAIN-UNIT penstocks for delivering water from Shasta reservoir, under heads up to 480 ft., to the 103,000-hp. turbines in the powerhouse are being fabricated at the dam-site because their diameters are too large to permit delivery by rail. The fabricating plant was built on the nearest adaptable area, which is near the town of Coram, Calif., one mile downstream from Shasta Dam. Here steel plates varying in thickness from ¾ to 2½ in. are welded into cylindrical sections 20 ft. long consisting of two courses of two plates each. Four plates, sufficient for one section, make up one carload as received from the Chicago steel mills where they are accurately curved to the required radius. A total of 8,000 tons of plates will be needed to complete the five penstocks, whose lengths range from 800 to 950 ft. In general, the 20-ft. sections will weigh from 20 to 45 tons. Several special sections of the thicker plates near the downstream ends will be 28 ft. in length and weigh as much as 70 tons.

At the start of welding operations, two formed, semicircular plates are assembled and tack welded together to form a cylindrical section 10 ft. in length. These cylinders are held in truly circular shape by "spiders" or spreaders, while the longitudinal seams are welded. These spreaders have 12 equally spaced radial bolts, 1½ in. in dia., one end fastened to a central hub and the other threaded into nuts spotwelded to interior pipe surfaces. With the bolts engaging these nuts, the tension in each bolt is adjusted so that the periphery of the section is tightly and accurately drawn to circular shape. In this manner plate distortions are minimized (tolerance $\frac{1}{16}$ in.) and plate offsets are eliminated.

The longitudinal welds are made by moving the cylindrical section lengthwise at a very slow, uniform speed on a car or table under an alternating-current, automatic arc-welding head attached to an adjustable arm. The speed of the car is set for the best welding speed. Two cylindrical sections are then mechanically fitted and tack welded, after

which the circumferential seam is automatically welded by the same welding head during rotation on the same apparatus.

Shop welding operations

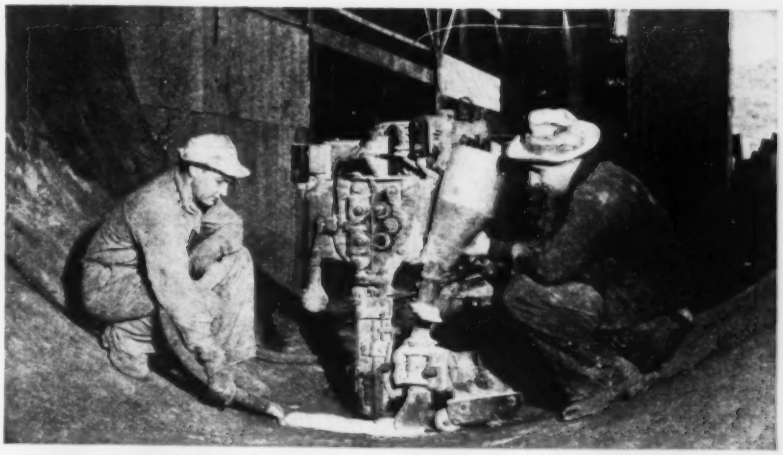
Where possible, all welding is performed by the so-called single-pass method. Repairs, where necessary, are made by manual welding using the shielded-arc process with heavily covered electrodes. A considerable amount of the manual welding is necessary for tacking, making special connections and in elbow bends where the seam is not in a plane normal to the center of rotation. The head in the automatic welder is mounted so that its supporting arm can be raised 16 ft. above the bed of the welding table. In this manner the head can function inside or outside the pipe sections. In all cases the welding apparatus remains stationary during the welding operation while the pipe itself is moved beneath the arc.

This apparatus is designed to complete a welded seam in two passes in plate thicknesses up to and including 2½ in. The first bead is made in such a way as to fuse the metal to a depth of half the plate thickness. The second bead, which completes the weld from the opposite face of the plate, penetrates deeply into the first bead, effecting a homogeneous bond in which there is complete fusion without a line of demarcation.

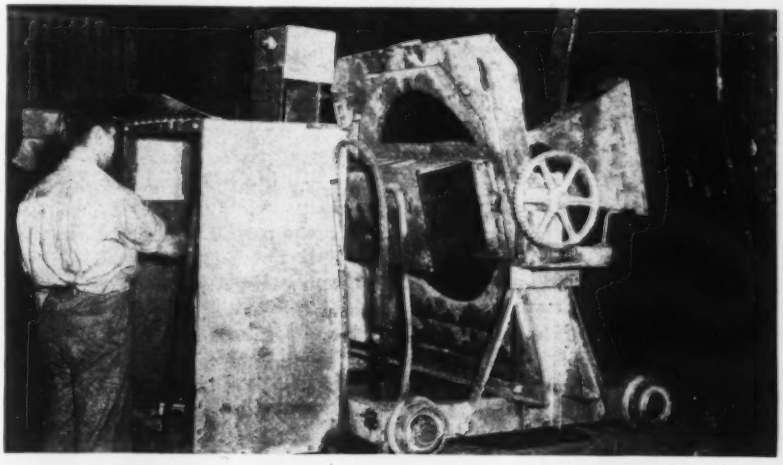
Voltage is held constant at 40 volts while the quantity of current flow is varied to provide the best fusion for a particular thickness of plate. As much as 1,800 amperes are used. To facilitate delivery of so much energy at low voltage, three transformers of 40-kw. rating are set nearby. Controls are in the welding head within easy reach of the welding operator. The welding speed, that is, the rate of progress of the car or table moving under the welding bead, averages 10 in. per minute.

The tack welds, made to hold abutting plate edges together, are made from the side opposite to that on which the first full-length weld is to be made. This is so that they can be removed, when no longer needed, to permit making a second continuous weld. Thus, there is no interference with continuity of the welds.

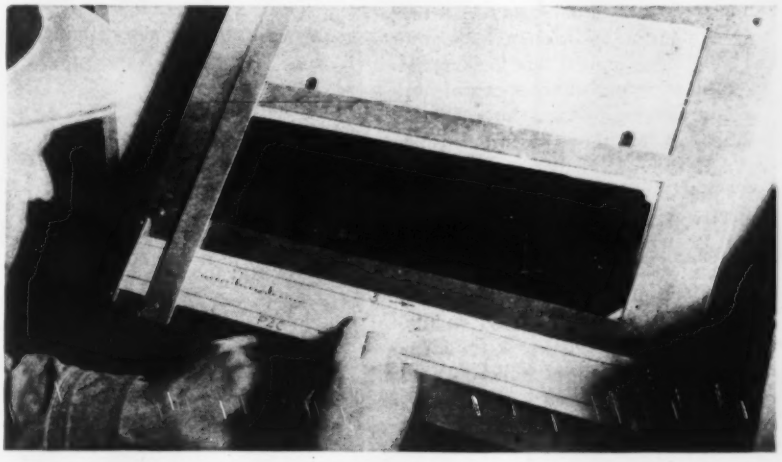
To maintain accurate control of automatic welding operation, tests of each plate thickness are made before the welding of the respective thick-



Automatic welding head working on a circumferential joint inside a section of pipe 15 ft. in dia. The pipe is rotating clockwise and the electric arc is hidden beneath the white powdered flux. Vacuum nozzle is gathering up that portion of the flux that has not been melted. Note welding wire from coil in background.



X-ray apparatus in position for making one of the 18,000 exographs. The pipe section is rotated to give a circumferential travel of 16 in. between successive exposures of the X-ray film.



Each exograph is inspected and imperfections are marked on a chip-out slip for guidance of welder. Each welder does his own repair work.

ness is put on a production basis. In addition, a 6x15-in. test coupon is welded at the end of one longitudinal seam of each section and is tested before the section is accepted. In this manner the uniformity and maintenance of high ductility, essential in this type of welded construction, is assured. These tests also serve as a check on the stress-relieving practice. Stress-relief acceptance tests of manual welds are also made in the same manner, using welded plate coupons made by qualified manual welders.

Welding electrodes for automatic use are supplied in 150-lb. coils, fed to the arc mechanically from a wooden spool or steel drum, thus avoiding frequent delays for renewal of the supply. The diameter of the electrodes used is $\frac{1}{4}$ or $\frac{5}{16}$ in.; a copper coating assures efficient electrical contact. To protect the molten weld metal from detrimental impurities that would form as the result of contact with air, a powdered flux is used. When a seam is ready for welding, the bead is moved into position over one end of the seam and the welding electrode carefully adjusted for position and arc length. The flux is then poured around the electrode and along the line of the proposed weld to form an elongated mound $1\frac{1}{2}$ to 2 in. high.

When the current is applied, the arc is hidden beneath this flux. A portion of the flux close to the weld metal is melted and adheres in the form of a crust to the hot weld metal as the welding head moves. The upper and outer portions of the flux are not melted and remain in powdered form. This powder is reclaimed by a suction nozzle resembling a vacuum cleaner, leaving only the melted portion adhering to the weld. The melted flux is removed in a plastic condition, speeding up and simplifying the cleaning of the weld. Use of the vacuum cleaner for reclaiming the flux results in a saving of a considerable quantity of material valued at 10c. per pound.

Radiographic examination

Specifications require radiographic examination of all welded seams. Each welder marks his work for identification with lead numerals which record his assigned marking on each exograph. Each welder is held responsible for any repairs that may be called for after exographs of welds made by him are examined.

The films used for this purpose are $4\frac{1}{2}$x17 in. in size, and give an effective length of 16 in. per exposure. About 20,000 such exposures will be required for the shop welding, including retakes which are made after imperfections have been chipped out and repairs made. Thirty-six films are needed for one circumferential seam. The X-ray apparatus is placed on the outside of the pipe section and the section is rotated 16 in. between successive exposures. The images are made on films placed against the seam encased in cassettes along the inner side of the section. The apparatus uses as much as 250,000 volts and 15 milliamperes for the heaviest plate, with decreasing amounts for lighter plates.

Before any welded seam is approved, the exographs are carefully examined and, if necessary, in making close decisions, are compared with standard exographs of (a) acceptable and (b) unacceptable weld defects of the same type as that in question. Where questionable, the comparison with the standard exographs showing extent of porosity and slag inclusions permitted by the API-ASME Code forms a basis for acceptance.

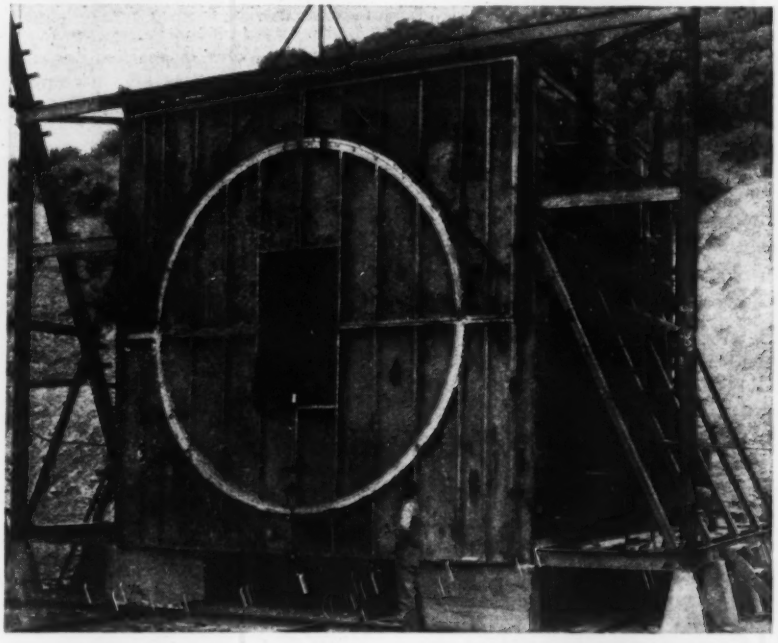
This method of comparison with two standard exographs, one showing permissible porosity and slag inclusions (in number and grouping) and the other a slightly greater amount of similar imperfections not considered acceptable, constitutes an accurate basis for rating the weld under examination.

At the start of welding operations the semicircular plates are tack-welded into circular sections.

Two other kinds of defects occasionally found in welds are (a) shrinkage cracks and (b) lack of fusion. There is no "tolerable amount" of deficiency in imperfections of this type. When they are detected, they are always removed, rewelded and repaired and then reexamined to make sure that all traces of them have been eliminated.

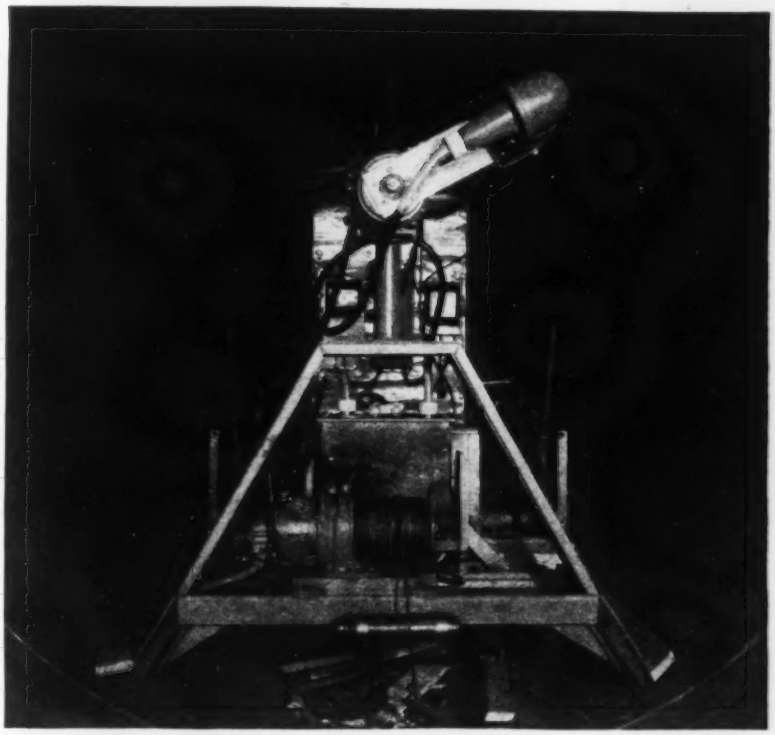
Stress-relieving practice

After acceptance upon completion of all repairs and radiographic exam-



The annealing furnace with doors closed. The 15-ft. pipe sections are heated to 1,100 deg. F. to relieve internal stresses that may be set up in welding.

ination, each penstock section is put into an annealing furnace and gradually heated to a temperature of 1,100 deg. F., held there for one hour for each inch of shell thickness and then cooled slowly to atmospheric temperature. The furnace used is a car bottom type, fired by 24 burners, 12 on each side of the furnace, insulated with special insulating brick to maintain uniform temperatures. Liquid butane, which passes through a vaporizer under forced draft before reaching the burners, is used for fuel. An accurate system of close temperature control is used consisting of five iron-constantan thermocouples leading from different furnace locations to an automatic temperature recorder, which graphically registers time and temperatures through the heating, holding and cooling cycle. During stress relieving, the sections are held to true curvature by cast-iron cradle supports and heat-resisting internal steel supports. The inside dimensions of the furnace are sufficient to permit stress-relief annealing of a section 15 ft. in diameter and 23 ft. long.



Portable X-ray apparatus used for circumferential seams inside sections that have been assembled in the dam. Head rotates through full circle. Rig moves on wheels set radially. Power winch used on grades.

Hydrostatic testing

Specifications require that each penstock section be tested under an internal hydrostatic pressure applied and relieved three successive times and maintained for 30 min. while undergoing inspection. The pressures required in these tests vary with the plate thickness according to the formula: $P = \frac{44{,}000T}{D}$ where P is the test pressure in lb. per sq. in., T is the minimum plate thickness, D is the internal pipe diameter in inches. Using this formula, the test pressures range from 180 to 570 lb. per sq. in.

To facilitate these tests, a testing apparatus was constructed at the Coram plant, consisting of a watertight steel mandrel over which the sections can be placed, and about which rubber gaskets are arranged to be fitted readily so that the annular space between the mandrel and pipe section can be filled with water and subjected to hydrostatic pressure (*ENR*—April 2, 1942, p. 512). The use of this apparatus reduces to a relatively small amount the quantity of water required for each test. No pipe sections have thus far shown defects under these tests.

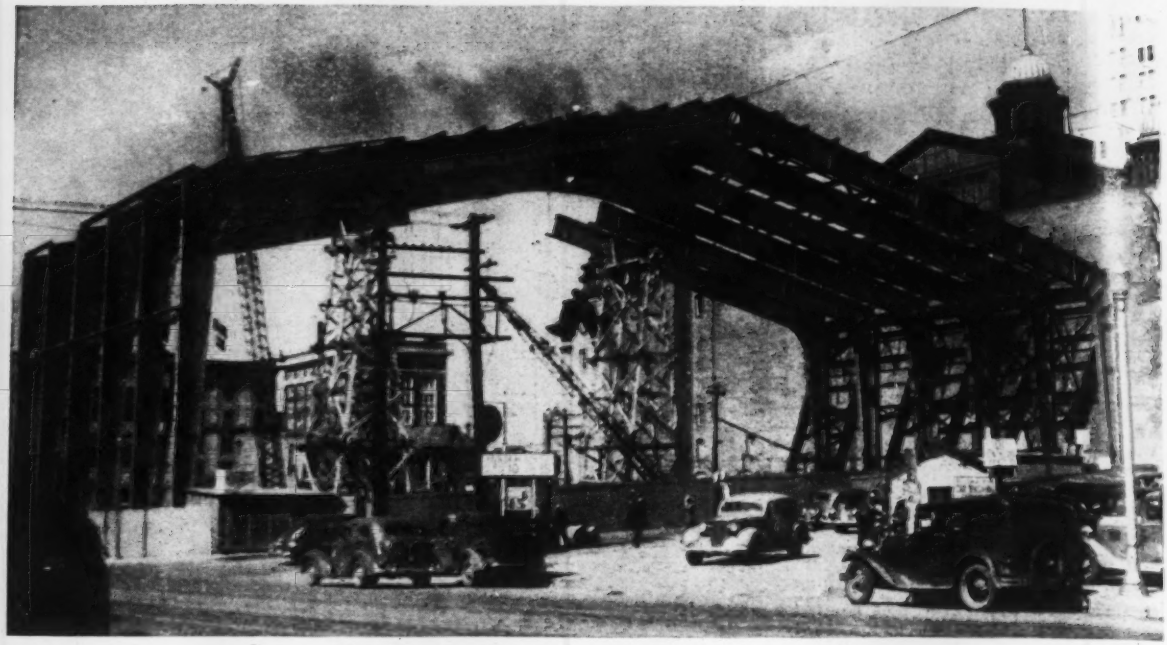
For hydrostatic testing of curved sections or elbows, which are not readily adapted for testing on the apparatus just described, a number of the sections are connected with temporary welds (removed after the test) into one continuous unit, thus permitting the test of several sections simultaneously. Some of these special test units have been made up in lengths as much as 112 ft. In such assemblies, the bends are so positioned that adjacent sections incline in opposite directions to permit the assembly to conform as nearly as practicable to a straight line. Hemispherical heads are welded on the two ends of these assemblies, the whole filled with water and subjected to the prescribed test pressure.

Transportation to the dam

Transportation of penstock sections from the field fabricating plant to the dam is being accomplished with a 50-ton trailer, caterpillar drawn, to a point on the construction road from which the sections are raised to their final locations in the dam by the overhead cableway. Sections are taken to the dam in the order needed for assembly in the penstock lines.

Portable equipment is used for the welding and X-raying operations carried on after the penstock sections have been assembled and fitted in place in the dam. The welding technique, in general, is similar to that used for manual welding at the field fabricating plant. To speed radiographic examination so that the acceptability of welds may be determined with minimum delay, a portable dark room was built, suitable for moving from one location to another along the penstocks as the work progresses toward the powerhouse. This dark room is equipped for loading and developing films and for preliminary examination of the exographs.

Field operations on the penstock manufacture and installation are under the general direction of Ralph Lowry, construction engineer, U. S. Bureau of Reclamation; the author is engineer for the bureau. The $1,587,000 contract for penstock fabrication and welding is held by the Western Pipe and Steel Co. of California; T. R. Rooney, superintendent; A. H. Wright, Coram plant superintendent. The X-ray work on welds, made after the sections are placed at the dam, is under contract to Industrial X-ray Laboratories, Inc., Seattle, Wash. Earle W. Watt is project superintendent.



Long span rigid-frame arches for Denver auditorium are erected in five sections.

Rigid-Frame Arches for an Auditorium

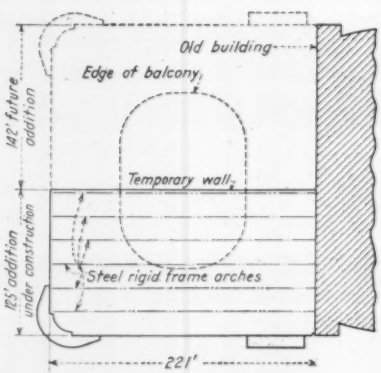
Paul J. Foehl
Structural Engineer, Denver, Colo.

***Contents in Brief**—The city of Denver is using steel rigid-frame arches of 214½-ft. span in constructing a $1,000,000 auditorium. Details of erection of the frames, the method of tying the walls to the members, as well as the method of supporting the balcony independently of the arches, are described.*

OUTSTANDING STRUCTURAL FEATURE of the 221x267-ft. building being constructed as an addition to the city auditorium at Denver, Colo., is the use of six steel rigid-frame arches of 214½-ft. span and 94-ft. rise. When complete the building will provide an arena floor at street level and an exhibition hall at basement level. A balcony surrounding the arena floor will seat 10,000 people.

The legs of the arches, which are on 20½-ft. centers, are tapered from 2 ft. 1⅞-in. over-all depth at their bottoms to 6 ft. 1⅞ in. at their haunches. The remainder of each arch has a uniform depth of 6 ft. 1⅞ in. overall, except for the increase in depth required by curved inside flanges at the haunches and the crown.

Each arch section is composed of a ½-in. thick web plate with each flange built up of two 8x6x⅝-in. angles and one 24x1 1/16-in. cover plate.



Structure now under construction is 125 x 221 ft. in area. Later a 142 x 221-ft. addition will be built and the old building will be remodeled.

The arches are supported at the basement floor level on 4½-ft. dia. cold-rolled steel pins. The pins are supported on welded steel bases, and the thrust of each arch is taken by a single 2⅜-in. dia. round tierod with 3-in. upset ends. These rods, which are located just under the basement floor, were purposely made larger than necessary from the standpoint of stress in order to reduce their deformation under load.

The soil upon which the building rests is ancient river bottom material consisting of firm sand and gravel. Footings for the arches and the permanent walls of the building are supported on wood piles, while the interior columns for the support of the arena floor and the balcony are supported on concrete spread footings.

Each arch is erected in five pieces with the aid of timber falsework and two cranes. Field splices are made just above each haunch and at each side of a center section. Two arches are erected at a time by means of

wooden towers, which must be moved only twice for all six frames. The erection procedure is to lift an arch leg into position and to hold it with one crane while the bracing frames between it and the adjacent arch leg are erected.

Then the second crane, equipped with a 100-ft. boom, lifts into place the 78-ft. long rafter section. This weighs about 16½ tons, and is the heaviest piece handled. The upper end of this rafter section is supported on the timber falsework, and when the lower end is spliced to the arch leg, still held by the first crane, both cranes are free to repeat the operation on the second of the pair of arches being erected. The cranes then move over to erect the other ends of the arches in the same manner, the crown sections going into place last.

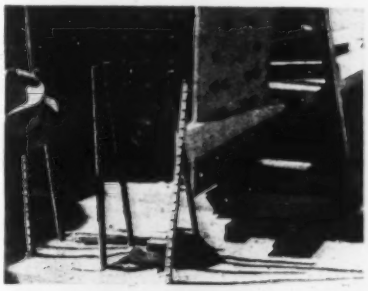
The steel roof purlins, which are on 8-ft. centers, and other roof framing are set after each rafter and crown section are dropped into position. The roof is constructed of pre-cast concrete tile with a 1-in. thick layer of cork cast into the bottom surface. Two inches of cork insulation is placed over the tile, and built-up roofing is installed over this.

Balcony supported independently

Because of the inherent movement of the arches under wind and snow loads, the balcony is supported independently of those members. For the same reason, much of the roof framing between the arches and the relatively rigid walls are pin-connected. However, the permanent side wall being built as part of the new addition is connected to the arch legs at about mid-height and at the roof line. This wall is of brick and is reinforced with steel rods to resist wind forces. Blue terra-cotta facing is used on the lower part of this wall, as is true with all the permanent walls, and buff brick facing for the remainder.

A flat concrete slab, supported on concrete columns spaced 22 ft. each way, is used for the arena floor, while the floor for the exhibition hall immediately below is a 6-in. concrete slab resting on earth. When complete, the balcony will consist of reinforced-concrete risers and treads supported on steel beams and steel columns.

Electric light fixtures are hung from the roof purlins midway between the arches. These fixtures are serviced from catwalks running between the arches at their crowns, a 2½x4½-ft. hole through each arch permitting passage from one catwalk to the next. A 4-in., I-beam, trolley rail, parallel to the arches and hanging from the roof purlins midway between the arches, extends from each side of each catwalk down to the last light fixture. A "bo'sun's chair," which can operate on any of these trolley rails, is lowered to the desired light fixture by means of a movable winch that may be bolted to the fixed support above each catwalk.



Detail at support of arch leg. The 4½-in. dia. cold-rolled steel pin is supported in a steel base built up of plates welded together. Note tierod clevis at extreme right.

Erection of last two arches with temporary falsework to be seen at left. The I-beam trolley track, for servicing lights by means of a "bo'sun's chair," can be seen between arches at top. Wall of 34-year-old section of the auditorium is in background.

Pay-as-you-go building

Since Denver is financing construction from current funds, rather than a bond issue, construction is advanced as funds are made available. The auditorium is now 221 ft. wide and 125 ft. long and encloses about 45 percent of the space to be provided eventually by the 221x267-ft. structure planned.

However, the entire development, which is expected to cost approximately $1,000,000, is now only about 35 percent complete, since little of the interior finish and balcony framing is in place. At one end of the new addition there is now a temporary wall, which will be removed when six more arches are added to complete the structure. Completion of the building, which was to have been this year, has been indefinitely postponed because of the unavailability of materials brought about by the war emergency.

Architects for the building are G. M. Musick and the late F. E. Mountjoy of Denver. R. M. Ross is in charge of structural steel design, the writer designed the arches, and G. M. Phillips was designing engineer for the foundations and concrete work.

The F. J. Kirchhof Construction Co., of Denver, was the general contractor. The structural steel contract was held by the E. Burkhardt & Sons Steel & Iron Works Co., Denver, while fabrication of the arches, because of their size, was sublet to the American Bridge Co., which erected the structural steel.

Historic Suspension Bridge

The suspension bridge at Kiev, Russia, destroyed by the Russian troops in their retreat, is reported to have been built in 1848–1853 by the English engineer, Charles Vignoles, by direction of the czar. Many difficulties were encountered in the construction, especially with the foundations in deep sand. Running ice carried away the cofferdams in 1848, but they were rebuilt with a protection of "fascine mattresses" around them, so that the floods and ice of 1849 did little damage.

Water and Sewerage Design Problems In a Boomtown Area

C. M. Stanley
Stanley Engineering Co.
Muscatine, Iowa

***Contents in Brief**—This is the story of how one consulting engineer adjusted his thinking to cope with the exigencies of war in planning facilities for two small communities that were suddenly confronted with three-fold expansion. Priorities called for substitutions of materials as well as changes in conventional design practice. And also there was the unique experience of planning a sewage treatment plant to handle a future load of only half the present flow.*

MUCH IS WRITTEN these days of gigantic defense projects and the engineering problems involved in their construction. The magnitude and importance of these projects over-shadow the problems they create in adjacent communities by the accompanying influx of the workers, who build and operate them. Resulting rapid increases in population often call for water and sewerage systems previously not required, the installation of which creates problems of engineering, finance, and management.

This article tells of the problems in two small Iowa towns located adjacent to a large war plant and outlines the design of sewerage and water systems for these communities and their expanded population. It also discusses changes from conventional design, which have resulted from the necessity of economizing on critical materials. The design of the sewage treatment facilities for one of the communities was further complicated because the plant effluent discharged into an area used for an impounding water supply.

The municipalities are Danville and Middletown, located a few miles west of Burlington. Danville with its population of 309 and Middletown with 134 people suddenly were expanded in size when construction operations began on the war plant, and the number of inhabitants grew to 1,200 and 400, respectively. Although the plant is nearing completion, there is little change in population because construction workers are replaced by operating personnel.

Neither of the towns had community water or sewerage facilities prior to the advent of the plant. Water was obtained from private wells, and sewage facilities consisted only of septic tanks and outdoor privies. Such arrangements were inadequate for the increased population and the resulting sanitation problems demanded prompt attention. But how were these two small towns to finance these needs? The principal reason why adequate facilities had not been installed heretofore w s the difficulty of financing them without very heavy taxes. To finance facilities for the expanded population would have been an even greater burden since the assessed valuation had not increased comparable to the population growth. And the uncertainty of future population and revenues prevented financing by revenue bonds. Municipal financing, therefore, was practically out of the question. Moreover, the town officials did not feel that they should be required to stand the full burden of the improvements.

Federal financial aid

After preliminary investigation, applications were submitted to the Defense Public Works division of the Federal Works Agency for financial assistance. These applications were filed in July and September, 1941, and in November grants were made for water and sewerage projects for both towns. In the case of Danville, the town will contribute $25,000 of the estimated total cost of $120,000 for improvements, and the federal grant will cover the balance. This town will construct, own and operate the system. Procedure is similar to that formerly employed on projects financed in part by grants from the PWA. In the case of Middletown, however, the contribution that could be made by the town was so insignificant that the Defense Public Works division has undertaken to finance the entire cost of $47,500, and will own and operate the facilities for duration of the emergency.

The lateness of the season at the time of approval of the projects made it undesirable to start them until the spring of 1942, and construction is scheduled so that the facilities will be in operation in June.

Water systems for the two communities are similar, in each case the supply being obtained from wells. The well at Danville will be carried to the St. Peter sandstone at a depth of about 1,200 ft.; at Middletown test wells have indicated that a suitable supply can be developed in a sand strata found in an old river channel at about 185 ft. Motor-driven turbine-type pumps will deliver the water to concrete storage reservoirs of 60,000 and 30,000 gal. capacity at the ground surface. Motor-driven booster pumps maintain pressure in the mains, with one or more of the pumps operating constantly. No elevated storage is included due to the unavailability of steel plates for such structures. Distribution mains will be of cast iron or asbestos-cement pipe, and the systems will include lead services to street curb stops.

Sewers for both communities are designed for sanitary sewage only, and will be of vitrified clay pipe. The treatment plants for the two communities, however, are not the same due to the difference in size and to the fact that the effluent from the Danville plant discharges into the drainage area of an impounding reservoir used for emergency water supply at the war plant.

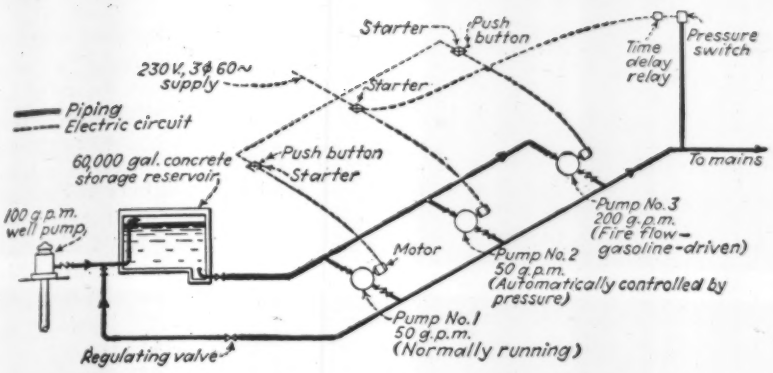


Fig. 1. Because steel could not be obtained for a tank, this arrangement of water-pumping units was devised as a substitute for elevated storage. A deep-well turbine pump discharges into a concrete storage tank at ground level, from which a booster pump forces the water into the distribution system under constant pressure. The control system is described in the text.

In the Middletown system a pumping station, using pneumatic sewage ejectors, takes the flow from the sewers and pumps it through a force main under the railroad tracks to the disposal plant. The latter consists of an Imhoff tank, dosing chamber, sand filters and sludge beds.

In Danville the sewage flows by gravity to the plant where it is lifted by centrifugal pumps into an Imhoff tank, which is followed by a trickling filter and secondary tank. Then, because of the need of an extremely high degree of treatment, the sewage is returned by another centrifugal pump to a twin dosing tank from which it flows to sand filters and finally through a chlorination basin before being discharged into a dry run. Rather elaborate provisions are made for bypassing flow around parts of the treatment plant. It is expected that the effluent will have a degree of purity seldom matched in plants of this capacity.

Saving critical materials

Design of these systems involved problems ordinarily not present in such projects. First, there was the necessity of conserving critical materials; second, there was the complexity of designing both for the temporary population during the war and for the probable smaller population after the war. The projects carry an A-4 priority which, as originally issued, covered all items except steel plates and structural steel for elevated tanks and cast-iron pipe. The order later was modified to permit the use of cast-iron pipe.

Efforts were made to minimize the use of structural steel, cast-iron pipe, copper, bronze, brass and aluminum. The changes required, except for the elimination of an elevated tank, were not difficult to make and are concerned largely with details of design.

For example, wood is substituted for steel wherever practicable on stairs, doors, windows, railings and platforms. Reinforced concrete is substituted for structural steel wherever possible. Precast concrete lintels and reinforced masonry lintels replace steel angles over doors and windows. Lead pipe is used on water services rather than copper. Bronze and brass have been eliminated wherever practicable, even where replacements may be required later. Alternate bids will be taken on cast-iron and asbestos-cement pipe for the water distribution system.

None of these changes mean a great saving of critical material, but in the aggregate they are appreciable.

However, the unavailability of steel plates and structural steel for an elevated storage tank has resulted in a major change from conventional design. Customary practice on systems of this size has been the use of an elevated tank—which floats on the system and maintains pressure—with the well pump forcing water directly into the system and being controlled by a float or pressure switch. When it was determined that a steel elevated tank could not be used, consideration was given to an elevated tank of concrete or wood. Concrete was discarded because of its excessive cost, and wood because of its lack of permanence.

Further study showed that the annual costs of pumping on the Danville system were only about $100 per year greater with ground storage and booster pumps than with the conventional arrangement. This increase is due principally to the difference in efficiency between pumping equipment operated at full capacity and part capacity. Therefore, an arrangement (Fig. 1) was adopted that provides a deep-well turbine pump discharging into a concrete storage tank at ground level from which the booster pumps force the water into the mains under constant pressure. At Danville, three booster pumps are provided having the following capacities and heads:

Pump No.	*Gpm.*	*Head*
1	50	100
2	50	100
3	200	120

All pumps are motor-driven, hori-

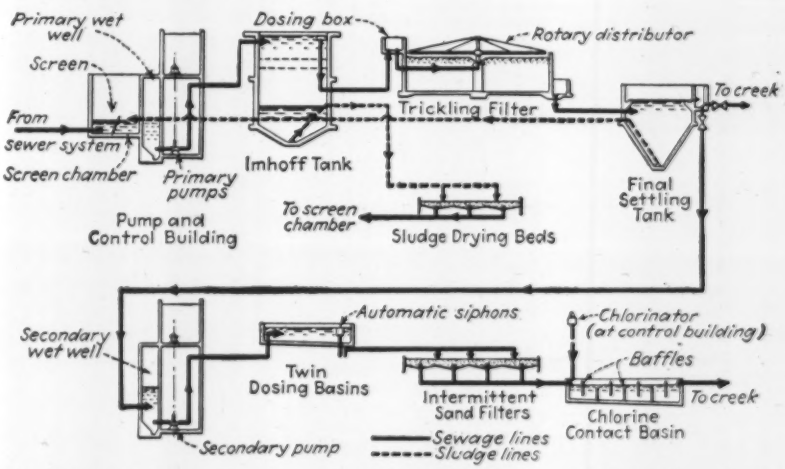


Fig. 2. Layout of sewage disposal facilities that will serve 1,200 people and produce a super-fine effluent suitable for discharge into an emergency water supply. It has been designed for easy conversion to the post-war needs of only 600 people, at which time the emergency water supply is to be abandoned and lesser treatment will be required.

zontal, centrifugal units connected to a common suction from the storage reservoir and to a common discharge header that runs to the mains. Ordinarily, only pump No. 1 will operate and pump No. 2 starts when the demand exceeds the capacity of pump No. 1. Pump No. 2 is provided with a control so that it is started by a pressure drop in the mains and continues to operate until the pressure exceeds normal. To avoid starting and stopping pump No. 2 as a result of surges in the system, a time delay is incorporated in the electrical control.

To protect the pumps against heating at low flow and to avoid building up too high a pressure in the system, a relief valve bypasses flow back to the storage tanks at a pressure a few pounds above normal. The electrical control of pumps 1 and 2 is arranged so that their functions may be interchanged in order to equalize pumping time on the two units. Pump No. 3 is for fire protection.

The Middletown system is similar to the one at Danville except that only two pumps are provided, one of 50 gpm. for normal operation, and the other 175 gpm. which will operate with the smaller pump to obtain suitable fire protection.

In order to assure a supply of water for fire protection in the event of an interruption to the power supply, a gasoline engine drive is provided for pump No. 3. This will be arranged for manual starting and will be used only in an emergency.

The arrangement described is not as satisfactory as one with an elevated tank, but it will cost even less than an elevated steel tank and much less than an elevated concrete tank. It will give dependable and continuous service except when the power supply is interrupted. At such times the gasoline drive on the fire pump may be used not only for fire protection, but to supply water for domestic consumption. At a later date when steel is available, an elevated tank may be added.

Problems of proportioning the units of the project to suit both the present temporary conditions and the more likely permanent situation may be illustrated by discussing the sanitary design of the Danville plant. The project is designed on the basis of a population of 1,200, or 400 percent of the 1940 population. Consideration of post-war operation has been based on an estimated population of 600 or less.

The well is to have a capacity of 100 gpm., thus furnishing 120,000 gal. per day on the basis of 20 hours operation. This is materially in excess of the expected consumption of 50 gal. per capita per day. With the ground storage tank of 60,000 gal., and the smaller booster pumps rated at 50 gpm. each, adequate capacity is available. The distribution system is designed to provide a fire flow of 200 gpm. at any point.

There were no problems involved in designing the waterworks system for a future decrease in population. The well pumps merely will operate fewer hours. The only probable mechanical change will be the installation of different impellers in the booster pumps to obtain better efficiencies at lower flows.

Sewage plant design

The general arrangement of the sewage treatment plant (Fig. 2) is unusually complex for one of this size. This has been necessary to meet the requirements of the State Board of Health due to the fact that the effluent from the plant discharges into a drainage area which contributes to an impounding reservoir for emergency water supply. Here the problem of design was to provide a high degree of treatment with the present population of 1,200, and, at the same time, provide a plant that in the future can be operated at a lower degree of treatment for a population of 600.

The basic design, therefore, called for a conventional Imhoff settling tank, a trickling filter, and a secondary tank, the hydraulic features of which are designed for a flow of 50 gal. per day from the design population of 1,200. The biochemical oxygen demand loading on the trickling filter, however, is about that which would normally be used for a 600 population. In order to provide the high degree of treatment required during the emergency, the plant just described is supplemented with sand filters and chlorination. These units will not only offset the higher loading on the trickling filter, but will result in a very high degree of treatment. A summary of the loadings of the plants under the two conditions is shown below.

For the future operation of the plant, it is contemplated that the sand filter and chlorinating facilities will be taken out of service. In order to protect against septic action with decreased flow, the settling compartment of the Imhoff tank is divided into two parts so that one of them may be cut out of service to maintain reasonable detention period. The detention period in the secondary tank will, of course, increase but this is not expected to cause trouble.

The treatment plant as designed will be capable of providing an overall B.O.D. reduction of about 95 percent which, supplemented by chlorination, will meet the stringent requirements laid down by the State Board of Health. When the war is over and the population decreases, the plant can be operated as a conventional trickling filter installation with the expectation of an overall B.O.D. reduction of 80 to 85 percent and with a considerable decrease in operating cost.

Both projects have been designed by the Stanley Engineering Co. of Muscatine, Iowa, under the supervision of H. S. Smith and the writer. Negotiations with the Defense Public Works organization have been carried on through the Chicago office, of which D. R. Kennicott is regional engineer. The contract for the Danville work has been let to the Dan Christensen Construction Co. of Cedar Rapids, Iowa.

DESIGN DATA FOR A SEWAGE TREATMENT PLANT TO SERVE 1,200 POPULATION NOW AND ONLY 600 PEOPLE IN THE POST-WAR PERIOD

Item	Present Needs	Future Needs
Population	1,200	600
Daily flow (gal. per capita)	50	50
Total dry weather daily flow (gpd.)	60,000	30,000
Design rate of dry weather flow (gpd.)	120,000	60,000
Lb. B.O.D. per day (a)	180	90
Detention in Imhoff tank (dry weather flow), hrs.	1.5	1.5(b)
Surface-loading Imhoff tank, (gal. per day per sq. ft.)	800	800(?)
Sludge volume per capita (cu. ft.)	2.4	4.7
Filter loading (lb. B.O.D. per acre ft.) (c)	440	220
Filter dosing rate (m.g.a.d.)	3.6	1.8
Detention, secondary tank (hrs.)	1.5	3.0
Sand filter dosing rate (gal/acre/day)	416,000(d)	Not operating

(a) At 0.15 lb. per capita.
(b) One compartment inactive.
(c) With 35 percent reduction in primary setling tank.
(d) Based on average daily flow.

Safe Water and Typhoid Toll

M. N. Baker
Associate Editor, Engineering News-Record (Retired)
Montclair, N. J.

***Editor's Note**—With every effort being made to safeguard water supplies and thus prevent epidemics in these critical times, it is profitable to review the relation of typhoid to safe water. And no one is better qualified than Mr. Baker who, for half a century, was a leader in anti-typhoid campaigns.*

No TYPHOID DEATHS were reported for 1940 by 41 of the 96 largest cities of the United States. Forty-three cities had rates under 2 per 100,000 population. Rates for the remaining 12 cities ranged from 2 to 3.6. For the 78 cities for which figures from 1910 to 1940 were available the average typhoid death rate fell from 20.54 to 0.48 in 31 years.

This rapid decline is shown by the accompanying curve, plotted from one of many tables given by the *Journal* of the American Medical Association in its twenty-ninth annual report on typhoid in large cities of the United States (Jan. 17, 1941).

Total deaths in the 78 cities fell from 4,627 in 1910 to 172 in 1940. Had the rate for 1910 been in effect in 1940 the typhoid toll of the latter year would have been nearly a million.

Fifty years ago, an epoch-marking paper by Prof. William T. Sedgwick and Allen Hazen was read before the American Statistical Association. Its title was "Typhoid Fever in Chicago." Its object was to warn visitors to the coming World's Columbian Exposition against contracting typhoid while there and to urge Chicago and other delinquent American cities to provide safe water supplies. The astounding revelations of the paper were so little welcomed either in or outside of Chicago that they were given little publicity in the newspapers.

Grasping an opportunity for service, *Engineering News* obtained a copy of the paper from Professor Sedgwick who gave the junior editor, who called on him, a never-to-be forgotten exposition of typhoid as a water-borne disease. The paper was published in *Engineering News* of April 22, 1892, p. 399. It showed that in 1891 the typhoid death rate in Chicago mounted to the unprecedented height of 166.4 per 100,000. The blame was put squarely on the ever-increasing pollution of Lake Michigan by the city's own sewage. Of other large American cities pictured, those with polluted water supplies had only less appalling typhoid rates while those with relatively safe supplies had rates then considered low. Foreign cities with filtered supplies had even lower rates. No large American city then had water filters.

TYPHOID HONOR ROLL

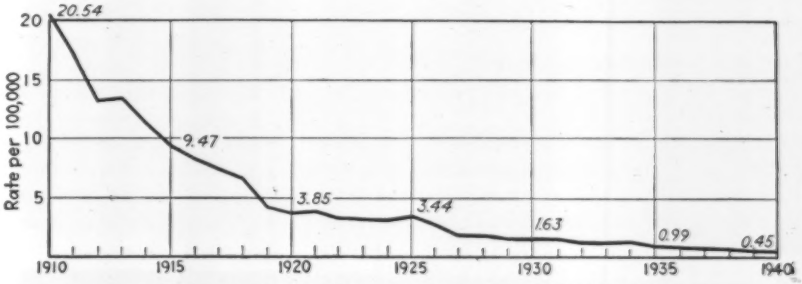
Portland	Cambridge
Fall River	Lowell
Lynn	New Bedford
Springfield	Worcester
Hartford	New Haven
Buffalo	Rochester
Utica	Yonkers
Camden	Newark
Erie	Reading
Scranton	Wilmington
Charlotte	Tampa
Jacksonville	Tulsa
Canton	Youngstown
Fort Wayne	South Bend
Peoria	Grand Rapids
Milwaukee	
Des Moines	Duluth
St. Paul	Wichita
Denver	Seattle
Spokane	Portland
Sacramento	San Diego

Publication of the Sedgwick-Hagen paper was the beginning of a campaign against water-borne typhoid by *Engineering News*. In 1917 it felt warranted in heading an editorial "Vanishing Typhoid" (*EN*, Mar. 29, 1917, p. 527). It concluded:

> "The publication of the paper had a profound and widespread effect, in Chicago and throughout the United States. From that date to this *Engineering News* has spared neither pains nor space in collecting, presenting and interpreting data showing the connection between polluted water and typhoid and how the danger can be overcome by legislation, improved sanitary administration, and particularly by the installation and efficient operation of water-purification plants . . . this is of course only a small part of its fight against sanitary and other evils in the domain of engineering. The whole program will be continued onward from April 5 next in *Engineering News-Record*."

This editorial was soon followed by one on "Engineers and the Typhoid Honor Roll" (*ENR*, Oct. 18, 1917, p. 723) prompted by a review of typhoid deaths for 1916 (*Jour. Am. Med. Assoc.*, March 17, 1917). That review divided 60 large cities of the United States into four classes: (a) 16, with rates of 5 per 100,000; (b) 19, with rates from 5 to 10; (c) 17, rates of 10 to 20; (d) 8, above 20 per 100,000. The editorial suggested the substitution of Honor Roll for First Class. The marked reduction of typhoid by 1919 led the *Journal* to put all cities having typhoid rates under 2 per 100,000 on its Honor Roll. In 1930, it raised the standard to include cities with no typhoid deaths during the whole year. There were 10 cities out of 93 on the Honor Roll for that year. On the old basis of 5 per 100,000, all 96 cities in the 1940 review would have gone on the Honor Roll.

To one who entered the anti-typhoid campaign fifty years ago it is a pleasure to review the marvelous decline in typhoid that has taken place. But eternal vigilance is still the price of safety!



Average typhoid death rates for 78 large cities of the United States in the period, 1910-40, which shows the rapid decline due to safe water.

Falsework for highway bridge arches across Grand Coulee Dam spillway. The eleven spans were formed at one time.

Falsework for Arches Set on Drum Gates

***Contents in Brief**—Falsework used to support the concrete arches of the 135-ft. span—that will carry the crest roadway across the Grand Coulee Dam spillway—was framed as three-post bents with brackets to support overhanging cap ends. Falsework sections were assembled in a panel yard and delivered by railroad and crane.*

FALSEWORK more than twice as high as it is wide was perched on the narrow spillway crest of Grand Coulee Dam to support the forms for a reinforced concrete highway bridge. Only a narrow working space was available at the crest of the dam so that two legs of the three-post bents supporting the arch form were carried on the steel of the drum gates. At the top of the bents a 38-ft. timber cap had its ends supported on brackets to carry the overhang outside the 21-ft. wide bent.

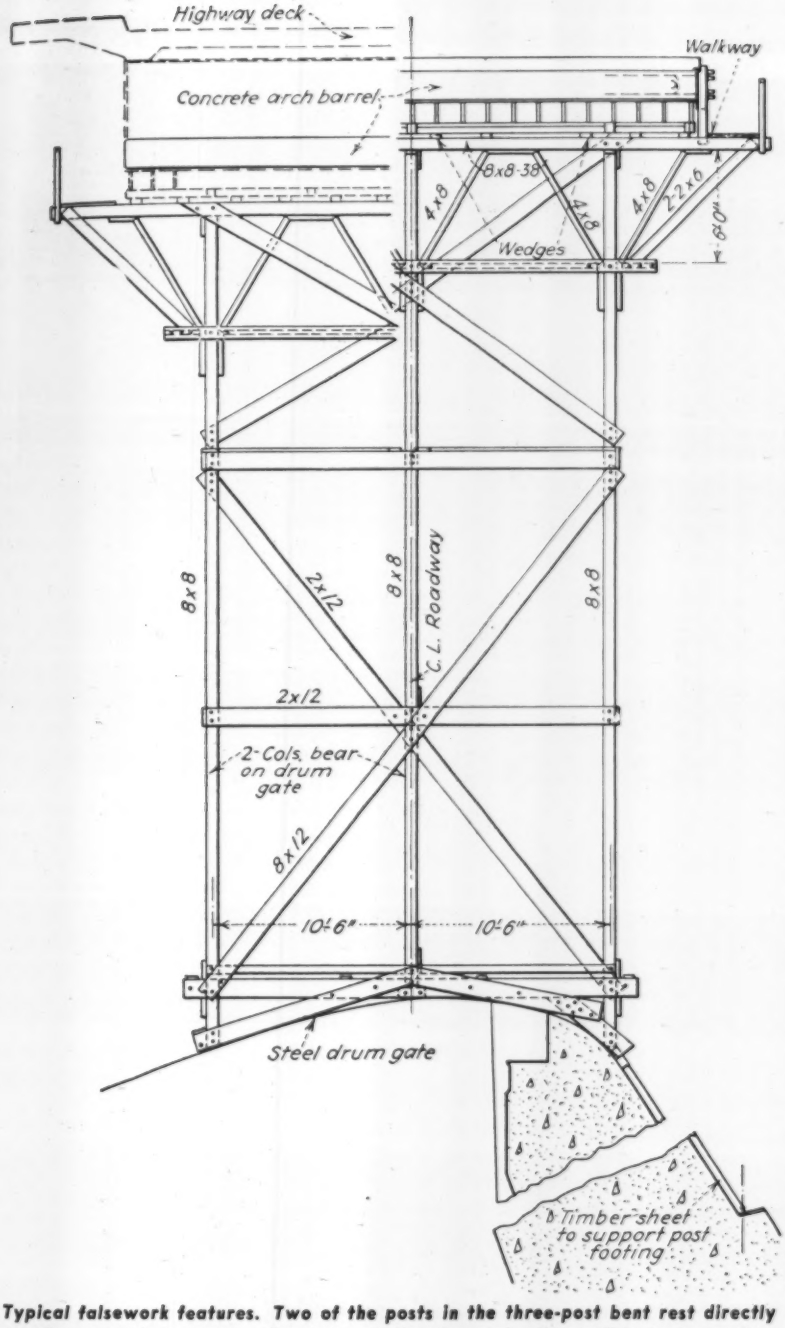
The bridge is a reinforced-concrete, open spandrel, multiple-arch structure supported by piers at 150-ft. centers. The eleven arches of the bridge, which are over the drum gates used for flood control, have clear spans of 135 ft. and a rise of 16.68 ft. in the variable thickness barrel. The roadway is carried on vertical concrete walls 12 in. thick, spaced at 10.75 ft. centers horizontally above the extrados of the arch.

In most cases it was possible to put the footings of the bent where they would bear on stiffener ribs in the steel drum gate structure. Where this could not be done, a 4-ft. length of 10x10-in. steel H-beam was used as a footing for the posts, thus making sure of transferring the load to the gate framework. The one-post bearing on the sloping surface of the concrete required a timber support to solid bearing as shown in the accompanying drawing. Horizontal bearing members in the falsework were avoided because of the relatively greater compression under load as well as objectionable swelling due to absorption of the curing water used on the freshly placed concrete.

Completely assembled falsework bents, sections of the decking and other parts of the temporary supporting structure were fabricated on the ground in an assembly yard and delivered ready for erection. A gantry-mounted crane and service railroad facilities previously required for other uses were available for handling the assembled falsework sections. Preassembly and erection in large units greatly decreased the amount of work that had to be done on the dam crest and speeded the construction of the falsework.

The desirability of salvage on almost 4,000 floor joists of 3x12-in. timbers (350 of these in each span) dictated a design which made it possible to fasten the joists securely without notching them. This saved time in assembly and greatly increased the salvage value of the lumber.

A definite pouring sequence was prescribed in the specifications to avoid the risk of unbalanced thrust on the piers during construction. The



Typical falsework features. Two of the posts in the three-post bent rest directly on the steel drum gates. Brackets at the top make it possible to support a 38-ft. cap on the relatively narrow dam crest.

seven pours prescribed for each arch, followed by the final 8-in. key pour, were required to begin with the crown, followed by filling alternate segments down to the haunch where simultaneous pours were required on both sides of the pier. Normal temperature of the concrete was taken as 40 deg. F. and adjustment of the falsework height, accomplished by the use of wedges, was made to assure that the finished barrel would be at the design elevation throughout. The walls and highway decks were placed in a separate operation at a later time.

The highway bridge is designed for H-20 loading; it has a sidewalk 6 ft. wide on the downstream side and 2 ft. 11 in. wide on the upstream side. Live load stresses, due to the H-20 truck-train loadings, were increased by an allowance of 30 percent for dynamic, vibratory and impact effects. As heavy power equipment may be hauled over the spillway bridge to the powerhouse, to be built later on the east bank, it was assumed that loads might cross the bridge on trailers with a loading of 85 tons.

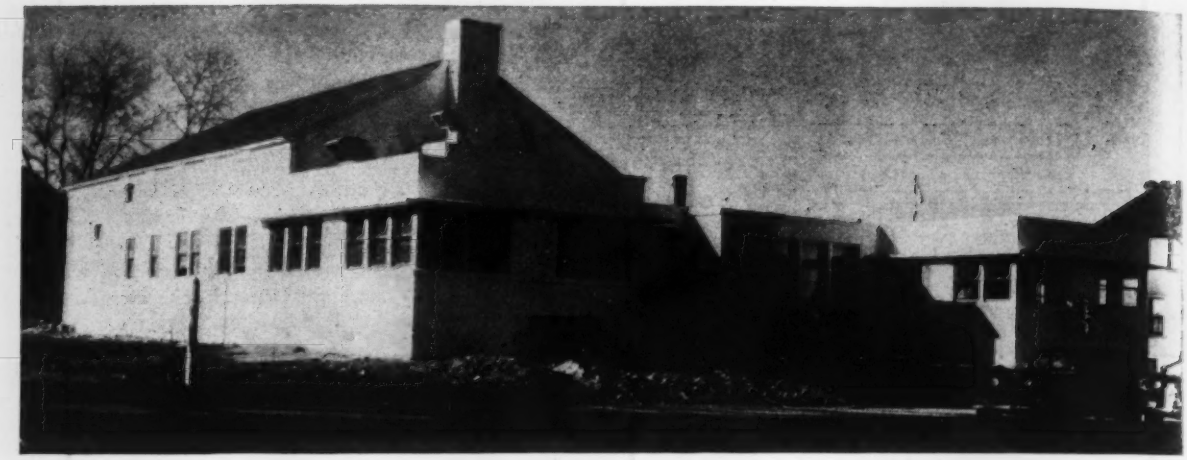
The work was done for the U. S. Bureau of Reclamation: S. O. Harper, chief engineer, Denver; F. A. Banks, supervising engineer at Grand Coulee Dam. The contract for the work was held by Consolidated Builders, Inc., for which A. R. Nieman was general superintendent.

Military Engineering in East Africa

Difficulties of an engineering force following troops driving a retreating enemy are outlined in a description of such work in East Africa, as given in the *Railway Gazette* (London) of Nov. 28, 1941. In this case the engineering force was a battalion consisting of a harbor section, a survey section and a construction section, composed of men from the South African Railways and Harbors Department. Its first job was to build a railway line in Kenya colony to serve the military advance toward Mogadiscio, following this by reconstruction of the port facilities at that place. At Villagio, a large steel bridge destroyed by the retreating Italians was replaced by a pile trestle in eight days.

Progress was halted at the Awash River, where a three-span bridge, 260 ft. above the water, had been wrecked by blowing up the two steel piers or towers. The center span was 160 ft., flanked at each end by a 140-ft. span. A 3½-mile detour line was built, with grades of 33 percent, crossing the river at a lower elevation. A main span of 120 ft. was built of members cut from the wrecked bridge, and was flanked by spans of 60 and 30 ft. This detour, with its bridge, heavy rock cuts, high fills, concrete culverts and track work was completed in eight weeks, in spite of climatic difficulties due to intense heat and a malarial region.

At another place, a 120-ft. through bowstring truss bridge which had been blown up and dropped into the river, was replaced by three plate-girder spans of 40 ft. on new piers. Further on, a 500-ft. tunnel had been blocked by a blast at mid-length, causing a cavity that extended 40 ft. above the rails. This tunnel was cleared and re-lined in four weeks.



This U.S.O. center at Waukegan, Ill., is one of 191 built throughout the country in 60 days.

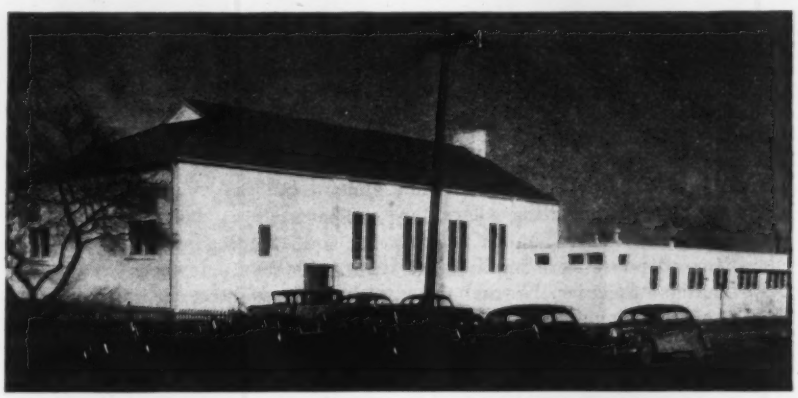
U.S.O. Centers Built on Fast Schedule

***Contents in Brief**—After a delay of nine months the building program of the United Service Organization was suddenly thrust upon the Army to complete in 60 days. A total of 191 recreation buildings, based upon seven standard plans and numerous alterations of existing structures, were completed on schedule in this country; 25 more were started at outlying bases. Construction costs varied from $33,000 to $255,000 each.*

LARGELY OVERLOOKED in the defense construction program last fall, but still a notable and substantial construction achievement, was the building of 191 United Service Organization recreation centers in this country in 60 days under the direction of the zone constructing quartermasters. An additional 28 centers were planned for outlying bases. Some of these were started, and even completed, but the fate of others, such as those at Hawaii and Manila, is unknown. The 191 projects in the U. S. cost about $14,000,000, those planned for outside were estimated at $3,500,000, including construction, equipment and land. Much of the land, however, was donated by local communities, or was leased on a long-time basis. Funds for establishment of the projects came from a blanket appropriation given the President. The units will be operated by U.S.O. through the Y.M.C.A., Salvation Army and other agencies with funds raised last year by popular subscription.

The U.S.O. recreation center program hung fire for about nine months last year, waiting determination as to who should build the projects and what funds should be used. For awhile it was thought the construction work would be carried out under the Defense Public Works division of the Federal Works Agency, and this department started working on plans. At one time WPA was considered as the construction agency. However, about Sept. 1 it was decided to turn the entire job over to the construction division of the office of the Quartermaster General, and plans were rushed to completion in that office. Actual construction in the United States was to be through the zone C.Q.M. offices, all work to be done by contract. Some hired labor was planned for units outside the country.

Once the program was decided upon, the buildings were wanted in a hurry. Working with the U.S.O. the zone C.Q.M. offices hurriedly designated the units to be built, their type and location. Often it was more advantageous to acquire an existing school, bowling alley or other similar building having possibilities of a large social hall, and remodel it to suit the particular needs of that unit rather than build a new structure. Again, special designs departing from standard were used for new buildings. In such cases the local zone offices



The simple treatment of the exterior design is expressive of the functional character of the building.

had to prepare the alteration or special plans as well as conduct all negotiations for the old building.

Paid for out of special funds, each project had to be approved by the President. The first group received such approval Sept. 29 and within two weeks practically all were approved. Then lump-sum bids were asked on two to five days notice and contracts were awarded on a 60-day completion schedule within a day or so after receipt of bids. Low bids ran from $33,000 to $225,000, averaging $70,000.

Seven plans used

Plans for seven standard types of buildings were prepared in advance, two of which are shown in the accompanying sketches. Of the 191 projects in the U. S., 27 were alterations to existing buildings and 20 were built to special plans to suit local conditions. The design of the remaining 144 buildings generally followed only three of the seven standard types, none being built of one type, and only a scant few of the other three. In several instances standard plans were modified to meet local needs. Wood-frame construction predominated, though 11 structures are of brick, brick veneer or masonry (concrete block).

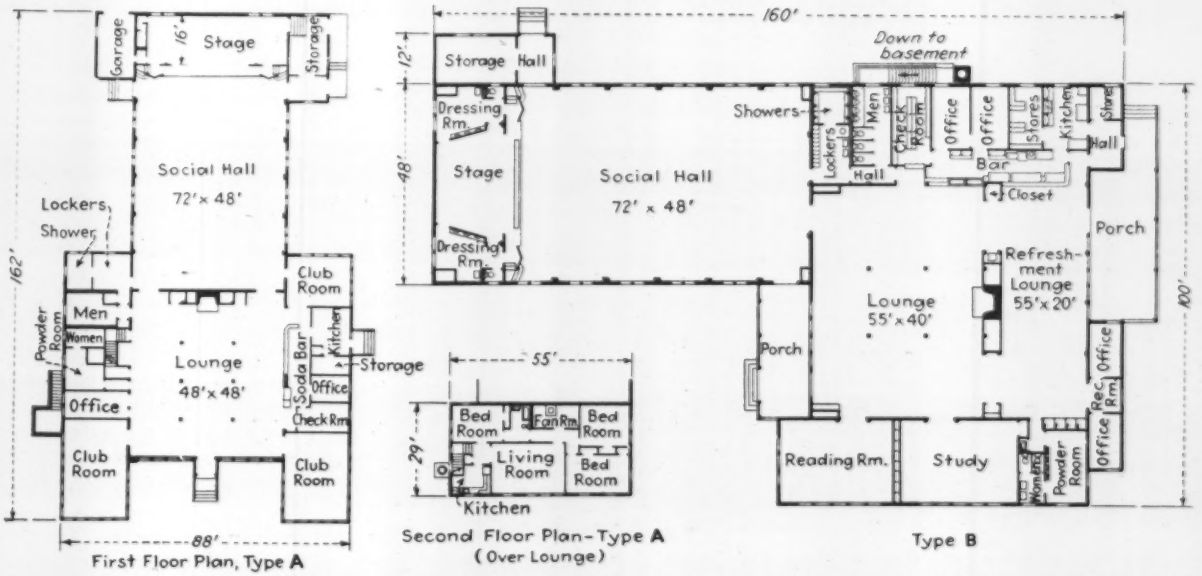
Plans for all new structures were developed around a high-ceilinged social hall, usually 48x72 ft. in size. In most types a stage extends across one end of the hall. The various plans have different arrangements and sizes of lounges, refreshment lounges, refreshment bars, reading and subrooms, offices and storerooms.

Timber trusses of 48-ft. span in the social hall at Waukegan. The stage is under construction at the far end of the room.

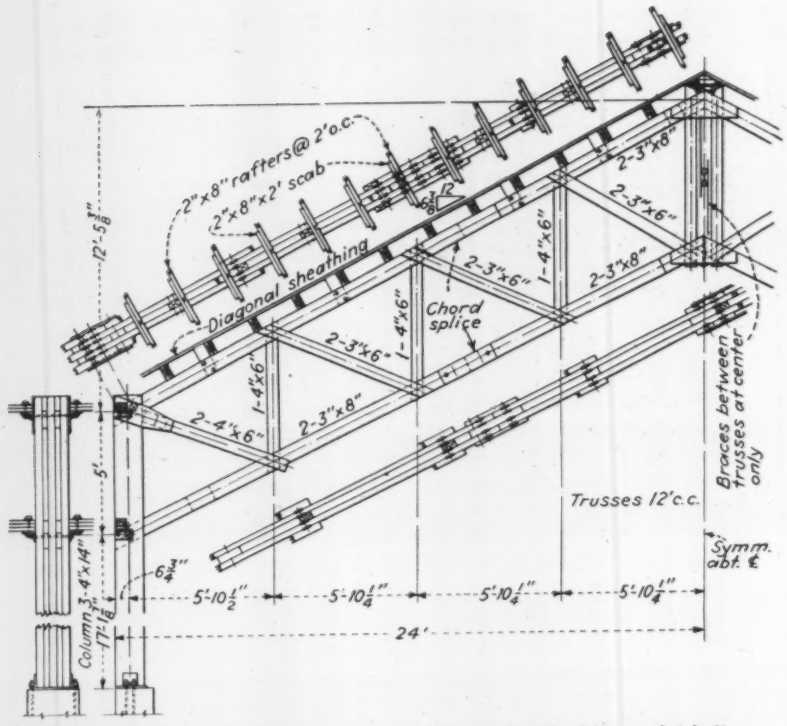
In the Type A buildings—the most common—a 16-ft. stage, a 48x72-ft. social hall and a 48x48-ft. lounge form one main structure 48 ft. wide and 136 ft. long. Off-stage are small wings for storage, while flanking both sides of the front are two wings containing clubrooms, offices, washrooms and a kitchen. The heating plant is in the basement.

The most interesting feature in the design of these buildings is the timber trusses over the social hall. Spaced 12 ft. apart, the trusses consist of parallel top and bottom chords of two 3x8-in. timbers. Web members are single and double 4x8-in. pieces and double 3x6-in. pieces. All fabrication is by bolts, split-ring connectors and shear plates. The trusses have a rise of 12½ ft., and clear the floor 17 ft. at the connection between bottom chords and columns. Each column consists of three 4x14-in. timbers, extending to the top chord of trusses, and resting on concrete piers at the floor level.

First to complete all of its allotted buildings was the Sixth Construction



Two of the seven standard plans prepared in advance. In many cases standard types were modified to suit local conditions.



Details of the 48-ft. span timber trusses used in nearly all of the social halls.

Zone, with headquarters at Chicago. This office built five frame and five masonry buildings and remodeled three old structures. All projects were approved between Sept. 29 and Oct. 4, though formal orders to proceed were not received from FWA until four to 15 days later. Contracts were awarded between Oct. 15 and 25. All were completed on scheduled time.

The job at Waukegan, Ill., is a typical example of the speed in construction. This project is a Type A building, modified to omit the standard second floor living quarters for the caretaker and the garage flanking the stage. Exterior wall construction is concrete blocks of light-weight aggregate on monolithic concrete footings.

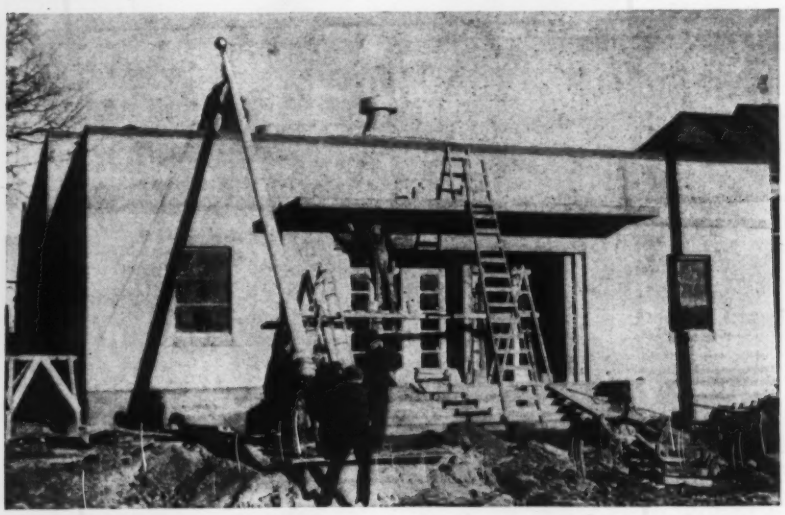
The unit received presidential approval on Sept. 29 and FWA issued an authorizing directive on Oct. 2. The deal for the site was closed Oct. 14, bids were opened Oct. 15, and contract was awarded the same day to Kaiser-Ducett Co., Chicago, for $79,020. Actual construction was started Oct. 22, and 52 days later the building was completed.

The concrete blocks were painted white on the outside, giving the building a most attractive appearance. In the social hall the blocks were left exposed on the inside, painted a buff color. The wood trusses, also exposed to view, were stained dark, while the timber columns were furred with concrete block. Interior of the remaining rooms, including the lounge, was finished with stained plywood. Floors are maple in the social hall, asphalt tile elsewhere. A steam boiler in the basement and three unit heaters supply heat.

Program direction

Cooperating with the U.S.O. were the following federal agencies: Federal Security Agency, Federal Works Agency, U. S. Corps of Engineers, and the Navy Bureau of Yards and Docks, the last two having jurisdiction over projects outside the U. S. All construction was under the Construction Division, Office of the Quartermaster General.

At Chicago, Lt.-Col. E. C. Hayden was Zone Six constructing quartermaster. Projects in this zone were directed by Capt. Edgar S. Thompson, Robert I. Randolph and C. Herrick Hammond.



Up goes the flagpole at the Highland Park (Ill.) project, one of the specially designed buildings.

British Railway Extend Use of Precast Concrete

Economy in the use of wood and steel enforced by the war has opened wide applications for precast concrete in the British railway system for repair of air-raid damage, replacement of normal wear and tear, and new extensions. The largest of the four main railway companies now makes 120 different standard units, mostly for structures, but also for signals and telegraphs. The central precasting shop has a weekly output of between 3,000 and 4,000 cu. ft., including standard units of up to 20 tons weight.

A stiff plastic mix is used, about ¾ in. slump. Smaller units are cast on two vibrating tables and carried away on a gravity roller or by a ½-ton chain block and runway. Concrete in the larger units is vibrated as placed by internal electric vibrators or by vibrators clamped to the forms. These units are loaded direct into railway cars by means of a 20-ton crane.

Dislocated Bascule Rocked into Position

S. J. Michuda
Engineer of Bridges, Department of Public Works
Chicago, Ill.

***Contents in Brief**—Trunnions of a 1,750-ton leaf of the 106th St. bascule bridge in Chicago were knocked loose from their bases by the wind when the leaf was in open position. Rather than try to slide the heavy unit back into place, the city bridge engineers devised an ingenious scheme of rocking the span by use of hydraulic and asphalt jacks which lifted all weight off the trunnions during the shifting operations.*

TWO UNUSUAL BUT IDENTICAL accidents to the east leaf of the 106th St. double-leaf bascule bridge over the Calumet River in Chicago called for unusual treatment. Last May a gust of wind caught the rising leaf while the bridge was being opened, increasing the speed of rise so much that the operator could not control the movement. As a result, the falling counterweight end of the span struck its bumping block so hard that the two trunnions carrying the leaf were forced shoreward on their bases, distorting the anchor bolts on the trunnion bearings. Though the bridge still could be operated, studies for permanent repairs were begun.

Before a decision could be made as to repairs, another identical accident to the same leaf on Sept. 5 put the span out of commission by kicking the trunnions partly off their bearings. The leaf weighs 1,750 tons, and instead of trying to slide such a weight back into place, a system of jacks, including a set of novel asphalt jacks, was used to lift and rotate the unit at the same time. Thus, the span did not slide, but was rocked back into place.

The double-leaf bridge is 62 ft. wide, 250½ ft. between trunnions. Each leaf, with its counterweight weighs 3,500,000 lb. and consists of two main trusses, each truss being supported by a trunnion. The trunnions are supported in a box abutment, the front of which is considered as a river pier, the rear as an anchor pier. As each span opens, the rear end with its concrete counterweight, drops into a pit within the box abutment. Upward motion of the leaf is halted by the counterweighted end coming to rest against timber bumping blocks. When closed, the rear of the span bears against an anchor in the anchor pier. Live loads on the bridge are carried by live-load bearings on each river pier, which, with the anchors, make a cantilever of each leaf.

The spans are raised and lowered by motor-driven gear trains, one for each truss, mounted on the masonry pit-wall. Each gear train terminates in a main operating pinion which meshes with a circular rack on each truss, centered on the trunnion.

Two accidents dislocate leaf

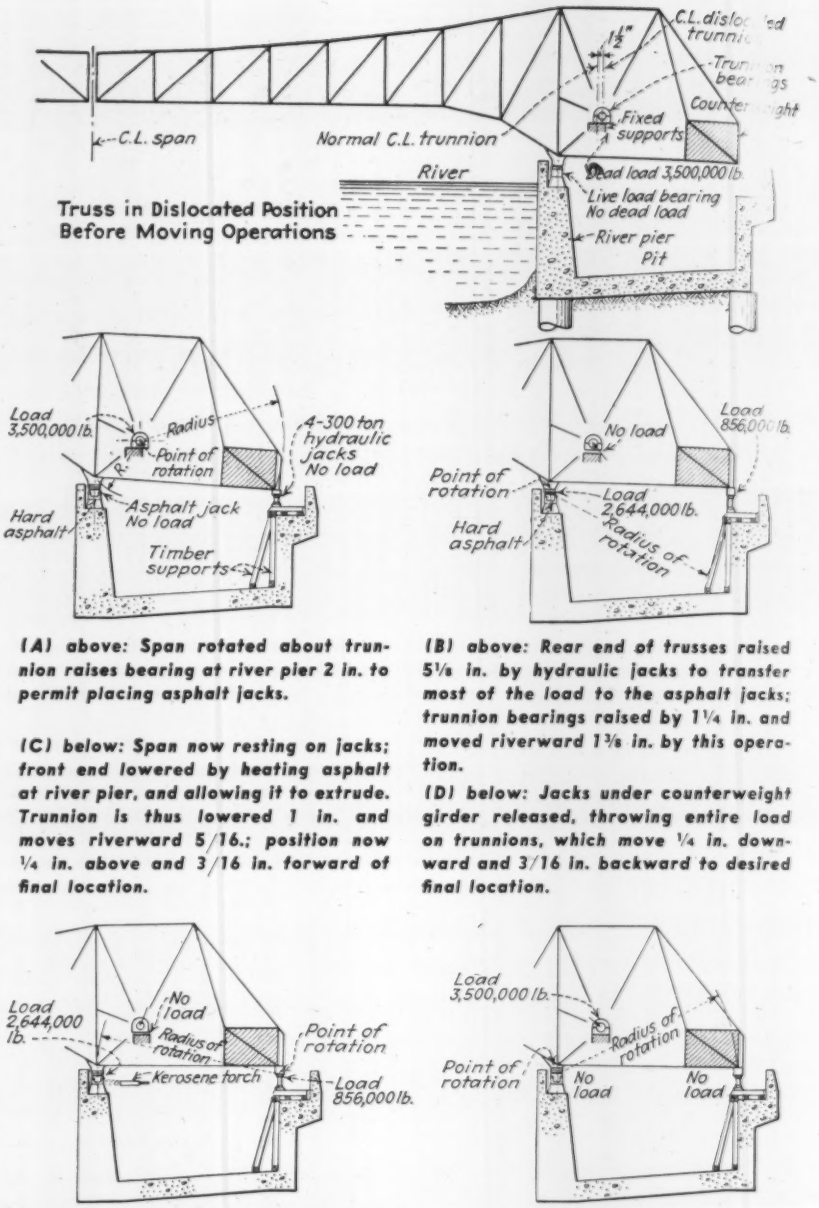
Both accidents resulted from a gust of wind catching the rising leaf from below while the span was being opened, accelerating the raising speed so much the operator could not prevent the counterweights from striking the bumping blocks with great force. The first time, the suddenly interrupted rising momentum of the leaf forced the trunnions back on their supports, distorting the base bolts in the trunnion bearings. This moved the racks away from the pinions, and though the two still meshed and the leaf still could be operated, repairs were considered necessary. Among several possible remedies were new and larger pinions, but their installation would have been difficult, traffic would be tied up for some time, and there was some doubt of obtaining the required cast-steel parts within a reasonable time.

While repair studies were underway, a second similar accident put the span out of commission. This time most of the trunnion base bolts were sheared off; the dislocation now amounted to 1½ in., disrupting the meshing of pinions and racks, and binding the finger joints at the roadway between the approach and the bascule span. Further operation became impossible, and the two leaves were blocked in open position to clear river traffic. By this time highway traffic was already detoured by approach paving work.

After the second bump it was ap-

Fig. 1. Homemade asphalt jacks that shifted the dislocated bascule span back into position. Note ports at lower end of cylinder for releasing asphalt.

parent that restoration of the leaf to its original position was necessary. To move a weight of 3,500,000 lbs., even 1½ in, and retain the fine adjustment necessary between the two bridge leaves and the accurate clearances at other points of the structure was a problem. Any plan which contemplated the sliding of this weight was considered impractical because of the difficulty in taking care of the frictional forces involved and the danger of creating other undesirable movements which might cause troublesome misalignment of the bridge span. Finally a plan was adopted which required no horizontal movement of loads on bearing surfaces, effecting the desired result entirely through raising and lowering operations by means of suitable jacks. Step-by-step details are given in the accompanying drawing.



(A) above: Span rotated about trunnion raises bearing at river pier 2 in. to permit placing asphalt jacks.

(B) above: Rear end of trusses raised 5⅛ in. by hydraulic jacks to transfer most of the load to the asphalt jacks; trunnion bearings raised by 1¼ in. and moved riverward 1⅜ in. by this operation.

(C) below: Span now resting on jacks; front end lowered by heating asphalt at river pier, and allowing it to extrude. Trunnion is thus lowered 1 in. and moves riverward 5/16.; position now ¼ in. above and 3/16 in. forward of final location.

(D) below: Jacks under counterweight girder released, throwing entire load on trunnions, which move ¼ in. downward and 3/16 in. backward to desired final location.

FIG. 2. STEP-BY-STEP OPERATIONS IN ROCKING SPAN INTO POSITION.

Asphalt jacks were homemade

The live-load bearing at the river wall under each truss is in two parts. The upper portion of each bearing was removed to make way for special homemade lowering jacks in which Trinidad asphalt was the supporting medium. Each of these jacks consisted of a 24-in. piston, with slightly rounded top surface, inside a cylinder fabricated from a series of plates up to 5 in. thick, welded into one solid block. At the lower end of each cylinder were two drilled and tapped holes, fitted with 1¼-in. screws seating on a 1-in. hole. These ports permitted escape of the asphalt from the inside of the cylinder to the outside through another 1-in. hole drilled at an angle and tapping the port within the block.

Before assembly of the cylinder and piston a weighed quantity of asphalt was melted into place in the bottom of the cylinder, filling the cylinder to a depth of 2 in. The jack assembly, with the asphalt in place, was 2 in. higher than the bearing it replaced. Thus, when the span was lowered to bear on the asphalt jacks, the river end of the truss was 2 in. higher than normal at the river pier and the counterweights were correspondingly 6 in. lower than normal by rotation of the leaf about the trunnion.

A steel grillage was erected at the rear or counterweight end of the pit, resting on timber bents and the anchor pier. On top of this grillage, bearing against each counterweight truss, were placed two 300-ton hydraulic jacks, each pair operated from one pump. On top of each pair of jacks a 4-in. plate distributed the jacking load over the counterweight girder. The web of this girder was stiffened with angles and bars welded in place.

With these preparations concluded, the temporary cables that had been used to anchor the displaced trunnion bearings were loosened and the counterweight girder was raised by the hydraulic jacks to a height of 5⅛ in. This caused the bridge leaf to rotate about the live-load bearing point, and made the trunnion rise a distance of 1¼ in. Since the trunnion center normally is above the live-load bearing, approximately as far as it is behind it, the trunnions also moved forward a distance of 1⅜ in. Because the trunnions had been raised from their supports by this operation, the total load of 1,750 tons was shifted to the asphalt jacks at the live-load bearing and to the hydraulic jacks at the rear in the proportion of 2,644,000 and 856,000 lb. respectively.

With the leaf thus supported entirely on jacks, heat was applied to the asphalt jacks by kerosene torches, and by careful manipulation of the

Fig. 3. Jacking system at rear of counterweight. Two hydraulic jacks under each side rest on steel grillage carried by anchor piers and timber bents.

port screws the melted asphalt was allowed to extrude under exact control, lowering the span at the live-load point as desired. This lowering was limited to $1\frac{5}{16}$ in., which caused a settlement of the trunnions of 1 in., and a forward movement of the trunnions amounting to $\frac{5}{16}$ in. The trunnion center was at that time $1\frac{1}{8}$ in. forward from its location at the beginning of the corrective operation and $\frac{1}{4}$ in. above that point.

Final adjustment operation

The trunnion bearings normally supporting the ends of the trunnions nearest the roadway are carried by curved girders spanning from the river pier to the anchor pier of the pit. In order to clear the counterweight the rear ends of these girders are considerably higher than the front ends. Consequently when the trunnion load is applied to these supports the deflection of the latter causes a downward as well as a backward movement of the trunnion center. Therefore, in order to avoid a sliding of the bearing on the support, it was essential that the final movement of the adjusting operation should also cause the trunnion center to be lowered and moved backward. This was accomplished by releasing the hydraulic jacks at the counterweight girder, thereby restoring the entire weight of the leaf to the trunnions and at the same time causing a settlement of the latter of $\frac{1}{4}$ in. as well as a backward movement of $\frac{3}{16}$ in. Thus, the elevation of the trunnions was brought to the original level and their center was moved forward a net distance of $1\frac{1}{2}$ in., without sliding.

When the leaf was again in its normal position, the hydraulic jacks were removed, the leaf raised, and the front pedestals restored in place of the asphalt jacks. All operations were completed to permit traffic over the bridge on Nov. 7.

The joints at the center of the bridge between the two spans are finger castings which mesh with each other. Any misalignment at this point would have required considerable work and expense for proper readjustment of the castings. The work of relocating the leaf, however, was so perfect that no adjustment was necessary. Furthermore, meshing of the main operating pinion and rack was better than heretofore, because when the original location of the pinions was made the full dead load of the fixed parts of the bridge, as well as the decking and other portions of the movable leaf, had not been installed. These additional weights caused deflections in the entire structure and its supports, which had to be allowed for by computation rather than by actual resultant conditions. The fitting of new base bolts for the trunnion bearings was accomplished after the bridge had been put in service.

All work required for the above adjustment was done by the city's own forces, the organization of which includes: Oscar E. Hewitt, commissioner of public works; W. W. DeBerard, city engineer; S. J. Michuda, engineer of bridges; James J. Versluis, engineer of water works construction; O. W. Hansen, engineer of bridge maintenance, and Carl A. Gaensslen, bridge designing engineer.

Steel Culvert Substitutes

Because of war-time scarcity of material for steel pipe culverts, state and federal highway authorities have indicated readiness to approve non-reinforced concrete and vitrified clay pipe for culvert service. To meet this situation the Northern California Concrete Pipe Manufacturers Association has prepared specifications for non-reinforced concrete pipe. After conferences with representatives of the California Division of Highways, the Public Roads Administration and the Association of State Highway Officials, the specifications summarized in the accompanying table have been announced by the concrete pipe manufacturers as the standards that can be used with general approval.

SPECIFICATIONS FOR NON-REINFORCED CONCRETE CULVERT PIPE

Internal diameter, (in.)	Min. shell thickness (in.)	Approximate weight (lb. per lin. ft.)	Minimum Average Crushing Strength (a) (lb. per lin. foot, three-edge-bearing) "D" test load requirements (b) 2,000D	3,000D	4,000D	Average Absorption (Max. Per-cent)
12	$1\frac{3}{4}$	80	2,000	xx	xx	8
12	2	90	xx	3,000	4,000	8
15	2	105	2,500	xx	xx	8
15	$2\frac{1}{4}$	120	xx	3,750	5,000	8
18	$2\frac{1}{4}$	150	3,000	xx	xx	8
18	$2\frac{1}{2}$	165	xx	4,500	xx	8
24	$2\frac{1}{2}$	220	4,000	xx	xx	8
24	3	270	xx	6,000	xx	8
30	$3\frac{1}{2}$	380	5,000	xx	xx	8
36	4	520	6,000	xx	xx	8

(a) Test loads for sand-bearing tests shall be one and one-half times those specified in this table for the three-edge bearing tests.
(b) "D" test load indicates the load in lb. per sq. ft. of horizontal diameter to which the pipe must be subjected under the standard three-edge bearing test.
(c) If it is necessary to increase the wall thickness over the amount indicated in order to meet crushing strength requirements, the internal diameter may be decreased by not more than 3 per cent, and the amount so decreased shall be added to the wall thickness.
(d) Minimum length of pipe sections 3 ft.
(e) All joints shall be tongue-and-groove type.

Emergency Road Net Laid Out For New York Metropolitan District

***Contents in Brief**—A system of secondary roads for use by the civil population in an emergency requiring use of main highways of the New York metropolitan district for military purposes has been selected and marked by the Metropolitan Defense Transport Committee. These "civil routes" parallel main numbered routes and have been given related numbers. Selection of routes for civilian use is part of a larger plan for maintaining the flow of essential supplies into the metropolitan district during any emergency.*

MARKING OF A SYSTEM of secondary roads to be used by civilian traffic in the New York metropolitan district in an emergency is now nearing completion. The work is part of a comprehensive program for maintenance of essential services in the district developed by the Metropolitan Defense Transport Committee. This program, in addition to the designation of routes for use by the civil population, includes plans for the maintenance of the flow of foods, fuel and other essentials into the metropolitan district and the primary distribution of those commodities should existing rail and highway supply lines be disorganized or existing distribution centers damaged by air attack.

Three states represented

The Metropolitan Defense Transport Committee is made up of representatives of the defense councils and related agencies of the states of New York, New Jersey, Connecticut, and the city of New York. The Army, Office of Civilian Defense, and the Office of Defense Transportation are represented by liaison officers. This central committee acts only as a coordinating agency; actual administration of plans developed jointly by the several defense agencies is left in the hands of the local bodies. Billings Wilson, assistant general manager of the Port of New York Authority, who as head of the operating department of the Port Authority is responsible for the functioning of the authority's interstate bridges and tunnels, is chairman of the metropolitan committee.

The plan for selecting and marking secondary routes to be used by civilian traffic when main routes are preempted by military forces was originated in England with the setting up of what are known as the red and blue networks. In the New York metropolitan district that plan has been expanded by the selection of two secondary routes roughly parallel with each main route into the metropolitan region. After the best routes had been selected and indicated on maps, the maps were submitted to the defense councils of the three states, to the New York City police department and to the highway departments of the three states for approval, after which the marking of the routes was undertaken by the respective state highway departments.

Fig. 1. Details of the secondary route signs used in the sections of New York, New Jersey and Connecticut that are included in the metropolitan district.

In many instances the routes selected for designation as routes of civilian travel in case of emergency are unmarked rural routes, city streets or short sections of existing routes marked for other purposes. Consequently, the civil routes were all given numbers in the 500 series related to the state or national route number of the main highway to which the civil route is roughly parallel whenever that was possible. Thus Civil Route 501 parallels U. S. 1 in New York and Connecticut and Civil Route 522 parallels U. S. 22 in New Jersey. A distinct type of sign was developed for these new civil routes.

Typical examples of the civil route marking are shown in Fig. 1 and 2. The boards are 16x16 in., painted white with black letters, and all carry the word "Civil," in addition to the route number. For obvious reasons, it was decided to mark the civil routes rather than the military routes. These new routes are to be shown on the maps of the metropolitan district issued by oil companies this spring so that citizens may familiarize themselves with the location of alternate routes that they may be called upon to use on short notice.

Elimination of bottlenecks

The committee now is engaged in listing the points that may prove to be bottlenecks when the secondary routes are put into service; it also is locating the points where these secondary routes have to cross main routes that will be taken over by the Army. The committee hopes that local agencies may be able to use defense highway funds for the elimination of some of the worst bottlenecks, and there is a possibility that temporary overpasses for the civilian traffic may be provided at such points. These might take the form of the demountable overpass developed by the LeTourneau Company of Georgia and tried out in Atlanta last year (*ENR*, Sept. 18, 1941, p. 395).

Emergency traffic control

Basic to the plans of the Metropolitan Defense Transport Committee is effective control over the movement of essential supplies into the heart of the metropolitan district during an emergency, especially the movement of perishable foods and fuel oil. Secondary receiving and dis-

Fig. 2. Signs for the "civil routes" are placed at major intersections and at all points where uncertainty as to the route might exist.

tributing centers are being selected, and routes to these points for rail, lighter and truck movements are being worked out. For the truck movements over the highways, police control points have been selected at outlying points on the main approach roads where trucks can be intercepted and directed to the emergency delivery point. In a test of this system conducted at six points in New Jersey, New York and Connecticut recently, gas stations and highway scale houses were used as the control points, being marked with large signs, and state police and motor vehicle inspectors at these points gave the truck drivers instructions as to how to proceed to the theoretical delivery point. Actually, the truck driver simply signed the instruction slip and turned it in at his normal delivery point to provide a check on how effectively the communication system worked.

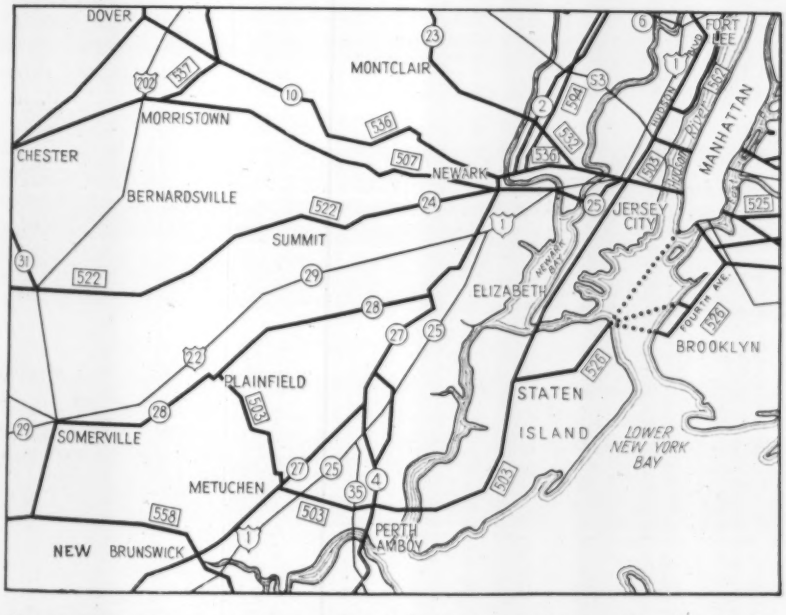


Fig. 3. Secondary routes approaching New York from the south and west. On this map the main routes that would be used by military forces in an emergency are shown only as light lines, and secondary routes for civil use are shown heavy. Through routes on this secondary system have been given numbers in the 500 series. This is a part of a map prepared for the whole metropolitan district.

By request of state or other agencies, the Metropolitan Defense Transport Committee has also given consideration to the problems of local transport and supply of petroleum to areas that might be blocked off during an emergency. Likewise, it has given thought to the problem of orderly movement of such portion of the population of the region as the authorities might decide to evacuate.

Tractor-Mounted Vibrator Used by German Troops

SEVERAL NEW TYPES of roadbuilding machinery have been placed at the disposal of German pioneer troops working on communications in occupied eastern territories. Typical of these in the crawler-mounted "tank" vibrator. Originally designed for compacting earth, the crawling vibrator now is used extensively for compressing soil-cement mixtures in road construction. The standard machine is equipped with a 9-hp. diesel engine and works at a speed of 10 ft. per minute over the comparatively narrow width of 3 ft. 4 in. Vibrations at the rate of 1,500 per minute are transferred to the crawler treads, resulting in compression of a 7 to 8-in. deep soil-cement mix by more than 1 in. under two passes of the machine.

The chief advantages claimed for the tractor-type vibrator over the usual cylindrical roller is that deep vertical compression is obtained without horizontal displacement. There is no need for precompacting by means of pneumatic rollers—another great advantage as rubber tires of the necessary diameter are scarce in Germany. As compared with the small electric vibrators hitherto used on a large scale, the caterpillar type saves time and labor. For most effective use, this vibrator is said to require a fairly wet mix except on moist ground where the vibration brings water up from the underlying soil into the mix.

A vibrator truck is now under development for use in conjunction with concrete mixers traveling at a speed of 12 to 20 ft. a minute. The types hitherto used in Germany do not work fast enough for that purpose. There also is a demand for a ramming instrument that is more easily movable, suitable for widening and repairing macadam roads where speed is an important factor.

Bridge Piers Encased Against Scour

H. L. Broadfoot and **W. A. Chalkley**
Construction Engineer — Asst. Civil Engineer
Kentucky Dam, Tennessee Valley Authority

***Contents in Brief**—At Kentucky Dam on the Tennessee River it was necessary to encase the concrete footings and timber pile foundations of the I.C.R.R. bridge below the dam with circular cells of steel sheetpiling driven through the river bed overburden to rock to prevent possible scour from concentrated flow of river diversion. Gravel fill within the cells and the encased overburden were both consolidated by grouting.*

PROTECTIVE MEASURES were required for the piers of the old I.C.R.R. bridge crossing the Tennessee River just below Kentucky Dam during building of the dam, for construction operations concentrate the entire flow of the river first under one half of the bridge, and later under the other half.

The bridge, a 7-span steel structure located 700 ft. below the axis of the dam, was built in 1905 (*Engineering Record*, Mar. 4 and May 20, 1905). The substructure is concrete piers founded on timber piles driven 8 to 27 ft. into the river bed. Depth of overburden adjacent to the eight piers averages 57 ft., with a range of 36 to 85 ft.

Model tests, made to study the effects of scour around the piers, indicated that protection of the piers was required. After completion of the dam, the railroad will be relocated across its top, and the bridge will be removed. The bridge is 1,670 ft. long between end piers with 1,600 ft. of timber trestle approaches. Three main channel spans are 305 ft. long, a swing span across the navigation channel is 455 ft. long, and two short spans are each 150 ft. long.

Concrete footings of the piers were 9 or 10 ft. below the top of the overburden at the time they were built. Investigations by TVA and the railroad company in 1936 revealed that considerable scour had already occurred around some of the piers, and at the swing span piers scouring had progressed to the base of the concrete footings.

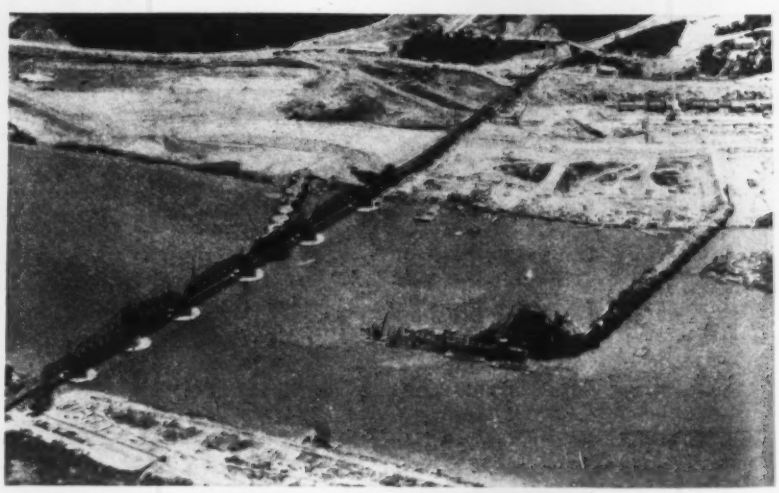
Two schemes of protecting the piers were considered by the TVA: (1) a heavy blanket of riprap around each pier; (2) enclosing each pier in a ring of interlocking steel sheetpiling. The latter scheme was adopted as the most effective and dependable, especially under heavy concentrations of river flow which might be expected.

Pier encasement

To determine the size and position of the pier footings the adjacent overburden was probed by a core drill mounted on a barge, and the outline of the pier so determined was plotted for superimposing a circle of minimum diameter. For the five river piers, cells 95½ ft. dia. were found to fit the conditions best. The footings of the two end piers, one at each river bank, required cells 81 ft. 2 in. in dia. Difficult pile-driving conditions, caused by the low headroom beneath the trestles at the end piers, were avoided by adopting semicircular cells with wing walls extending into the bank at these points. The elevation of bedrock was determined by drilling four diamond core-drill holes 5 ft. into rock adjacent to the predetermined corner of each pier footing. These borings indicated that sheet piles, ranging from 51 to 95 ft. in length, were required for the cells to be seated on bedrock and protrude 1 ft. above low water.

Driving of steel sheetpiling through 85 ft. of overburden was the major construction problem. Previously, a test cell of interlocking steel sheetpiling had been driven to bedrock and excavated (*ENR*, May 11, 1939, p. 666) for determining, among other things, the feasibility of the work and the condition of the piling after having been driven through 95 ft. of overburden such as existed at the dam-site. This test proved that the deep driving was practicable, and the driving of the protection cells around the bridge piers was the first positive application of the deep driving at Kentucky Dam.

The templates, around which the sheetpiling was racked and driven, consisted of two flights of 12 prefabricated arched-timber sections that were supported 15 ft. apart on 21 timber piles 45 ft. long, and driven to a firm bearing about 12 ft. into



Sheetpile cells around the piers of the old I.C.R.R. bridge below Kentucky Dam protect the substructure against scour. Construction of the first stage of the cofferdam is also shown here.

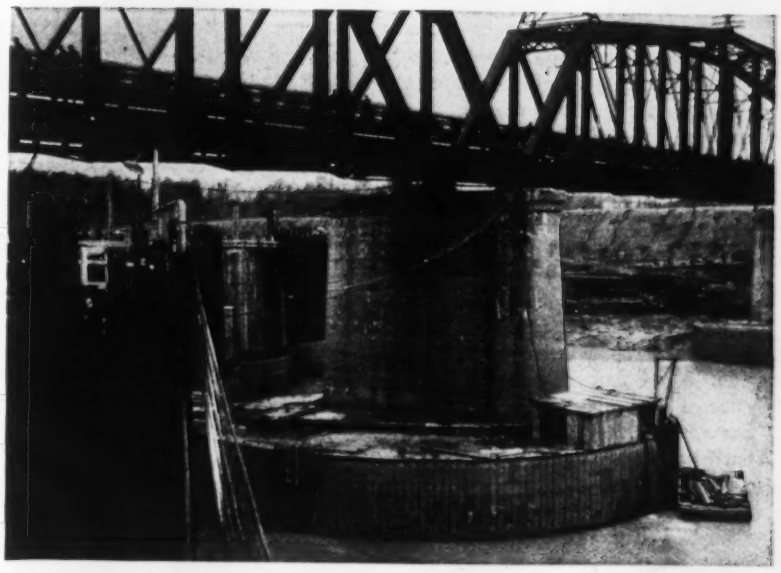
the river bed. The piles were braced against the concrete bridge pier by 8x10-in. struts. Second-hand sheetpiling was used for the cells.

Floating oil-fired steam derricks and cranes were employed for racking the piles and handling the steam hammers. Due to the limited reach of the floating hoisting equipment, it was impossible to handle the sheetpiling in single sections of sufficient length to reach from bedrock to the top of the cell. The restricted headroom beneath the bridge also limited the length of piles. Therefore, the piles beneath the bridge were divided into three sections, the others into two sections. Splices were made with 6x9½x¼-in. steel plates welded to the inside of the lower pile. The plate was not welded to the upper pile because the cells will not be salvaged.

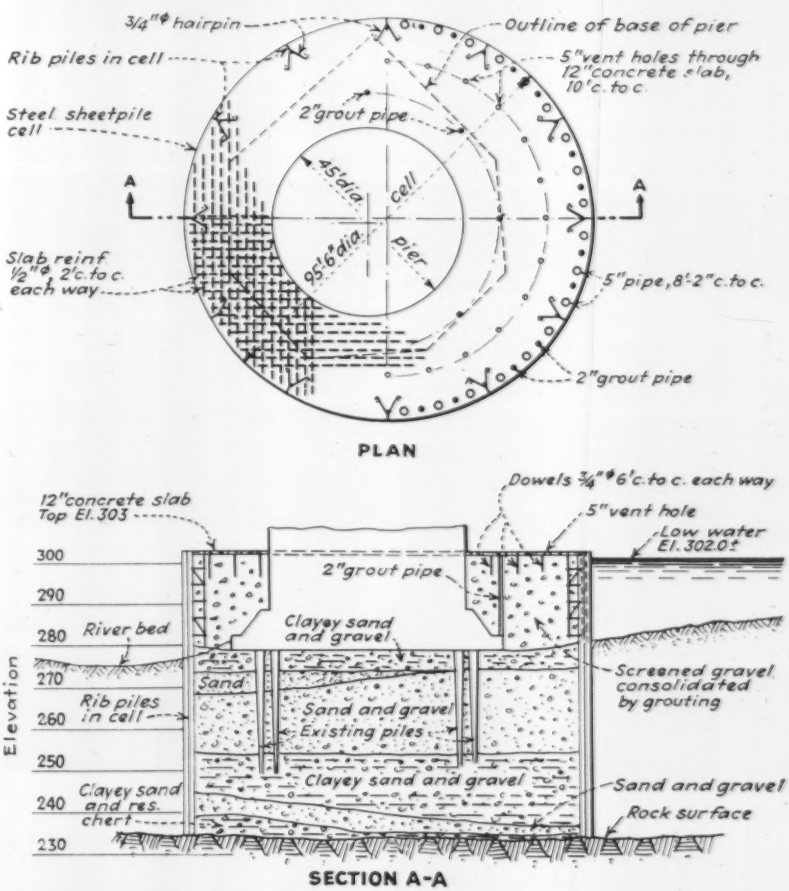
Twelve "tee" piles were incorporated in the periphery of each river cell for attaching two rib piles located radially on the inside of the cell. These were added to stiffen the cell and to provide a bond between the sheetpiles and the consolidated cell filling that was added later. To aid in bonding the filling to the piling, ¾-in. steel hairpin rods were inserted through holes burned into the web of the inner rib pile on 4-ft. vertical centers.

The piles were driven in pairs progressively 4 ft. at a time by inserting a temporary filler pile, or follower, on top of the low pile to fill the differential created by the overlapping. When the tops of the piles neared the template so that the fishtail leads on the pile hammer were obstructed, the filler piles were removed and the second sections of piles were racked and spliced. Before driving the lower sections below the water level, all handling holes were covered by welded plates. When the piles neared bedrock, or when they had been driven to such depths that the driving was difficult and there were possibilities of damaging the piles, the interval of consecutive driving was reduced to 2 ft. When bedrock was reached by driving the piles in pairs, a follower was attached to the hammer and each pile was tested individually for seating on rock.

Occasionally when driving the upper section of piles, the driving would suddenly become difficult and then just as suddenly become easy. When such a condition occurred, the driving was stopped, and by means of a submarine exploring tube, the pile was inspected. Usually it had slipped off the top of the lower section, bent the splice plate, and ruptured the pile interlock. Such piles were removed and replaced by undamaged piles. This exploring tube was a watertight galvanized metal tube, 6 in. in dia., and closed at one end by a glass plate sealed with gaskets between two stand-



Completed concrete-capped cell around one of the eight bridge piers.



Typical cell construction is shown in the above details of the protection around the swing span pier. Work at other piers is similar.

ard pipe unions. A light was attached to the outer side of the tube below the glass viewing point, and by submerging this end of the tube and bringing it near the pile to be inspected, the pile could be seen by peering into the top exposed end.

Some piles refused at a higher level and others appeared to penetrate deeper than the rock elevation, as indicated by the adjoining piles. When the trouble could not be located with the exploring tube, a diamond core-drill hole was bored adjacent to the pile. These holes revealed the presence of bent piles, residual boulders, fissures, or other obstructions. Twelve such holes were drilled, but only one pile in the river cells was found to have a ruptured interlock below the river bed. This was cared for by driving a secondary row of piles inside the cell between two "tee" piles added to the two rib piles nearest the break. Other piles investigated by drilling were found to have been driven into vertical solution channels in the rock or landed upon residual boulders. Another ruptured interlock was discovered, but its depth could not be definitely determined, and the pile, being composed of several unconnected sections, could not be removed. Consequently, a heavy blanket of riprap was placed against the river side of the cell and extended across the river bottom to the next adjacent cell to form a weir which would divert the flow from the cell and also retain the cell until the enclosed material could be consolidated by grouting. Prior to placing the riprap, a steel bar was welded across the split and the interlocks were welded from the top of the split down to the ground level.

Cell-filling scheme

Upon completing the pile driving, the timber templates and the supporting timber piles were removed, and the cells were filled from the river bed to within 12 in. of the top with ¾-in. minimum size gravel dredged from the river. Material smaller than ¾-in. was not used because of the plan to consolidate the fill by pressure grouting with neat cement. Before beginning the pressure grouting, a 12-in. reinforced-concrete slab was placed on top of the gravel filling. Vent holes were formed in the slab to prevent displacement by the grouting operations. Dowels, 6 ft. c. to c. each way, extended downward 4 ft. into the gravel to anchor the slab.

The material enclosed by the cells was consolidated by grouting to insure the stability of the cell against the most severe condition of river flow which might scour the river bed from around the outside of the cells and permit them to spread, thus causing settlement of the piers. Grouting was in two major stages: first, consolidation of the gravel filling, and second, consolidation of the natural overburden enclosed in the cell. At the outset, it was planned to consolidate all of the gravel filling between the river bed and the under side of the concrete cap. Experience with the first cell grouted indicated that a substantial saving in cement could be effected with equally as satisfactory results by confining the grout to the lower 3 ft. of gravel filling. This provided the desired seal over the natural overburden which confined the second-stage grout to the overburden when consolidating that portion of the cell. It also provided anchorage for the rib piles and hairpin reinforcing which, being anchored to the concrete slab at the top, would effect a beam support for retaining the cell should the overburden be washed from around the cell and a pile interlock be split.

For injecting the grout into the lower 3 ft. of gravel filling, 32 2-in. pipes were installed in each cell. Twenty-four of these were located around the periphery of the cell, 2 ft. inside the sheetpiling. The other eight pipes were located on lines 2 ft. from each side of the concrete pier. The pipes were installed prior to filling the cells with gravel, and the lower 2 ft. of each pipe was perforated with ⅜-in. holes. The sixteen pipes on one side of a pier were connected through a valve at each pipe to a header leading to the grout pump. A return line to the pump was also provided. The pipes on the other side of the pier were connected in a like manner to a second grout pump.

After a short water test to determine that no pipes were plugged, all valves to the grout holes but one were closed, then neat cement grout with a water-cement ratio of 0.60 was pumped into the hole until 5 cu.ft. had been injected. The valve to this hole was then closed and the one at the next hole opened, and the grouting procedure repeated at each succeeding hole until the circuit was completed. Grouting was then resumed at the first hole and continued around the circuit at the pumping rate of 5 cu.ft. per hole per hr. until refusal at a pressure of 25 lb. per sq.in. Constant inspection of the water outside the cell was maintained during the grouting operations to detect any grout leaks through the pile interlocks. On occasions dye was pumped into a hole to aid in discerning leaks.

The grouting of the natural overburden enclosed by the cells was confined, as much as possible, to the shell of material directly inside the steel sheetpiling. By consolidating and making this material immobile, it acts as a protective sheath which would retain the soil supporting the bridge pier should excessive scour remove the overburden from around the cell and expose an undetected ruptured interlock of a sheetpile.

For grouting this portion of the cell, 36 5-in. steel pipe casings were installed prior to filling the cell with gravel. This was done to eliminate drilling through the gravel. The pipes were located in a circle 2 ft. inside the sheetpiling, and extended from the top of the river bed to the top of the concrete cap. Selected clay was tamped into the bottoms of the pipe casings prior to installation to exclude the grout injected into the gravel during the first-stage consolidation. Upon completing the first-stage work, 2-in. pipes were placed in the 5-in. casings and driven through the overburden to bedrock. They were then independently connected to the grout pump and grouted to refusal at a pressure of 35 lb. per sq.in. Upon refusal with the pipe at bedrock, the pipe was raised about 2 ft. and again grouted to refusal. This was repeated until the top of the natural overburden was reached, the pressure being gradually reduced to 25 lb. at the top of the overburden. Sawdust was added to the grout for holes, which did not refuse after absorbing 50 bags of the thickest grout.

Direction of work

Kentucky Dam, which includes the protection work at the railroad bridge, is being constructed by the Tennessee Valley Authority, of which T. B. Parker is chief engineer, and A. L. Pauls is chief construction engineer. In direct charge of the work at the site is G. P. Jessup, project manager, and B. S. Philbrick, construction superintendent. J. B. Hays was construction engineer when the pier encasement was done.

From Field and Office

Working problems and time-saving methods for engineers and contractors

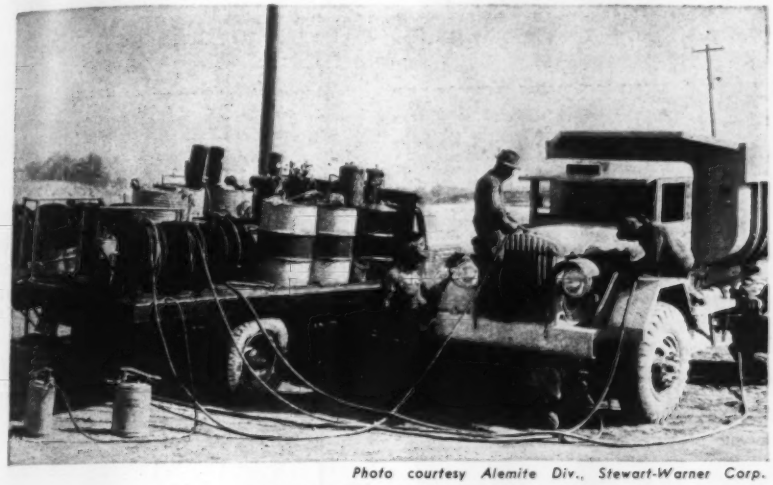
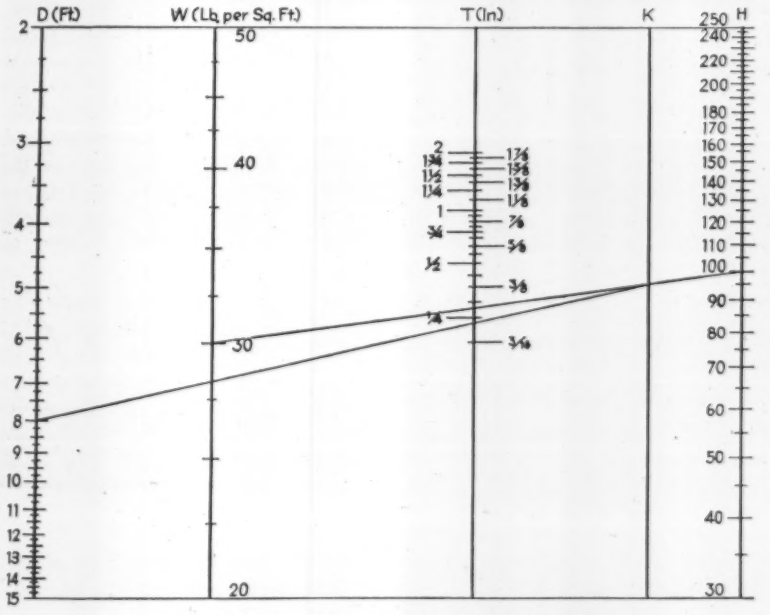


Photo courtesy Alemite Div., Stewart-Warner Corp.

PORTABLE SERVICE STATION

On the TVA Cherokee Dam work a portable service station equipped with pumps, compressor units, and reels as shown in the accompanying photograph is being used successfully. This makes possible several men lubricating simultaneously and saves considerable money and man hours.



Shell thickness for designing steel stacks.

Steel Stack Shell Thickness

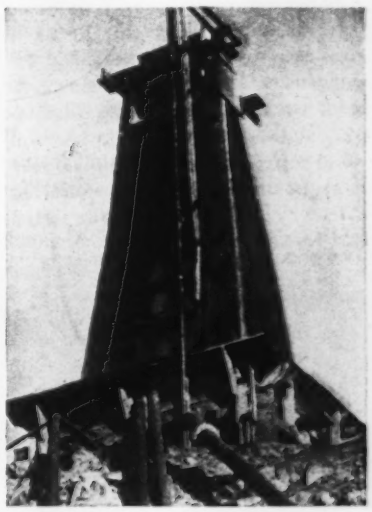
In steel stack design the problem is generally to find the thickness of the shell knowing the height and diameter of the stack and the wind force in pounds per square foot. To facilitate the calculation use has been made of the accompanying chart in recent powerhouse work handled by the writer.

The procedure is: (1) Start on scale W with the known wind pressure in pounds per square foot of the projected area; (2) draw a straight line to the height of the stack in feet on scale H; (3) from the intersection of the above line with K (auxiliary line) draw a straight line to D, known diameter of the stack in feet; (4) the intersection of this last line with the scale T indicates the shell thickness in fractions of an inch.

The lines on the chart show the solution in case of a stack 100 ft. high and 8 ft. in diameter, with a wind pressure of 30 lb. If it is required to design a stack for a stress s_1 other than 12,000 psi. and an efficiency e_1 other than 0.70, then the result T obtained from the chart should be multiplied by $\frac{8,400}{s_1 e_1}$.—SAMUEL LEVINE, *Director, Structural Division, Manhattan Technical Institute, New York, N. Y.*

Cooling Tower at Keswick Dam

A cooling tower, built to serve contractor's equipment at Keswick Dam on California's Central Valley project, has screens on all four sides



An effective but low-cost cooling tower built by Keswick Dam contractor.

designed to expose to the air a thin sheet of water so as to obtain maximum cooling due to evaporation, without an appreciable loss of water on windy days. The water is divided equally at the top of the tower to the two upper baffles, which direct the flow outward to the screens. The screens tend to spread the flow into thin sheets, which follow the screens down into a timber tank below.

The screens are inclined, permitting baffles to be so placed that the drip from one baffle strikes the top of the one next below and is thus

again deflected to the screen. In this way highly effective cooling is accomplished, it is reported, and the screen prevents the wind blowing away any appreciable amount of water.

The tower was built by the Atkinson Kier Co., holder of a U. S. Bureau of Reclamation contract for construction of Keswick Dam.

Flame-Straightened I-Beams

Intense, localized heat from an oxy-acetylene flame was recently used successfully to straighten two steel 38-in. I-beams, which were 32 ft. long and bent approximately 6 in. out of line at their centers, according to a brief account of the work in *Oxy-Acetylene Tips*. One operator in four hours straightened both beams by repeated applications of heat on local areas, alternating with periods of cooling. A heavy-duty welding blowpipe was used as a heat supply, which made possible heating a comparatively small area rapidly without greatly affecting the nearby metal.

In preparation for heating, the beams were laid on their sides, as shown by an accompanying illustration. Each beam was held in position by two supports, one placed under the far end and one near the bend in such a way as to leave an unsupported end of considerable length. This assisted in upsetting the heated metal.

The operator's procedure was to heat a triangular-shaped area on one flange at the apex of the bend. Once this area was red hot, he moved to the corresponding point on the opposite flange and repeated the operation. By the time the second section had been heated the first area was cool and ready for reheating. The alternate heating of the sections and allowing them to cool gradually drew the beams back into a straight line.

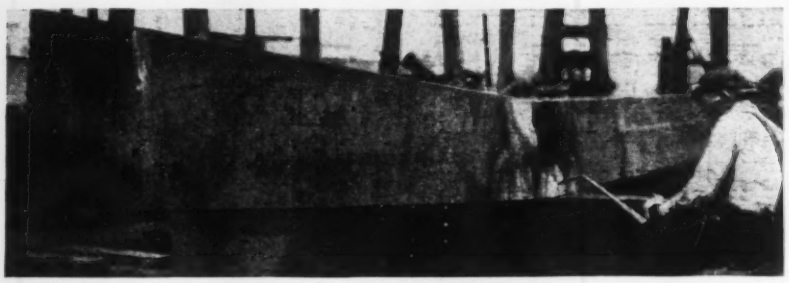
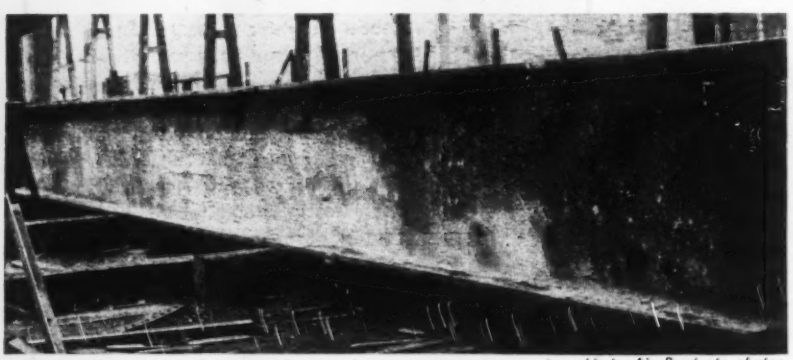


Fig. 1. Triangular-shaped area at apex of bend is heated with heavy-duty welding blowpipe.



Linde Air Products photos

Fig. 2. One of the beams after being straightened in two hours by one operator.

National Paving Brick Assn. Photos

HAND SPURS AID ON REINFORCED BRICK WORK

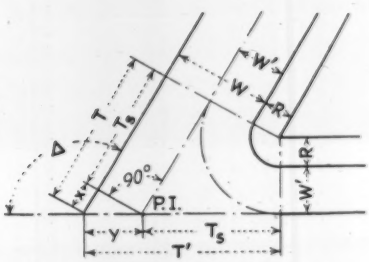
On construction of about one mile of reinforced brick pavement of 8x8x3½-in. units by the Illinois Division of Highways the hand spurs illustrated above proved very useful for handling the 19½-lb. pieces. They consist of a piece of leather and an angle iron attachment that straps over the hands as shown. The inventor, a veteran brick dropper, advises there is no more physical fatigue to the arm and wrist than during an average day with standard size bricks.

Field and Office Comment

Tangent Distances

Sir: The formula for tangent distances for runway intersections submitted by Joe L. Grimes Jr., Corpus Christi, Tex. (*ENR*, Dec. 4, 1941, p. 817) is very interesting, but in following it through the question occurs: Why go to all the trouble suggested by the solution?

Having derived the formula, the calculations involved are rather laborious. Why depend on an involved formula when the solution, as the accompanying sketch shows, involves the use of simple functions and calculations which are as familiar to



every engineer as 2 plus 2 equals 4? For example, referring to the diagram:

$Ts = (R + W^1)$ Tang. $\frac{1}{2}\ \Delta$
$y = (W - W^1)$ Sec. $(\Delta - 90°)$
$x = (W - W^1)$ Tang. $(\Delta - 90°)$
Then:
$T^1 = Ts + [(W - W^1)$ Sec. $(\Delta - 90°)]$
$T = Ts + [(W - W^1)$ Tang. $(\Delta - 90°)]$

R. E. Stallings
City Engineer
City Hall
Tucson, Ariz.

Book Notes and Reviews

The month's addition to the engineer's reading and reference list

Through An Engineer's Eyes

MODERN BATTLE—By Major Paul W. Thompson. 221 pp. W. W. Norton & Co., New York. $2.75.

While hardly an engineering text, this book warrants attention in these pages, first, because it was written by an engineer — one-time Freeman scholar studying the peaceful problems of hydraulic research in European laboratories—and second, because no small part of its content relates to the work of military engineers in some of the great offensive operations of the present World War. By piecing together all available information, Major Thompson has been able to develop an outline of what took place during the retreat to Dunkirk, at Sedan, Crete and in other parts of Europe.

Surveying from the Air

AEROPHOTOGRAPHY AND AEROSURVEYING—By James W. Bagley. 324 pp. McGraw-Hill Book Co., New York and London. $3.50.

Lt. Col. James W. Bagley's eminent work in photogrammetry through a period of many years places him in position to speak with authority on all phases of the subject; and his recent book, "Aerophotography and Aerosurveying," prepared with the cooperation of Alexander Hamilton Rice and the Harvard Institute of Geographical Exploration, constitutes one of the most important contributions to the literature in this field.

The book provides a wealth of information concerning aerial photogrammetry, covering nearly every phase of the subject. Equipment for both field and laboratory is described in complete detail; operational methods are discussed with exacting thoroughness, beginning with the original photography and extending throughout the various methods for map construction; the geometry of the aerial photograph and the fundamental theory of stereoscopic measurements are presented in such a manner as to insure a thorough understanding of the methods of map construction; and many details are included, even to the geodetic methods for obtaining control data. All of this material is presented in a clear style and arranged in a logical manner, with copious illustrations and geometric figures to facilitate the reading. The book is indeed a very coherent and comprehensive treatment of the subject of aerial photogrammetry.

In view of the fact that, although aerial photogrammetry has already been accorded its deserved place as an important means of topographic mapping, technical training in this science has as yet not even approached any standardization, either in course content or in the method of presentation, Colonel Bagley's book at this time seems destined to serve three important purposes. First, it will certainly prove to be an excellent reference book for complete and authentic information on photogrammetry; second, it will serve as an excellent basis for a series of lectures to be introduced into advanced surveying courses in technical schools where instruction in photogrammetry is provided in this manner; third, it will doubtless serve as most welcome textbook material in many institutions where comprehensive courses in photogrammetry are being inaugurated.—*Reviewed by* EARL CHURCH, *professor of photogrammetry, Syracuse University.*

Basic Data on Buildings

BUILDING CONSTRUCTION—By Whitney C. Huntington. Second Edition. 674 pp. John Wiley & Sons, New York; Chapman & Hall, London. $6.

Revision and rewriting of this book, which was published originally in 1929, has been so extensive as to make it almost a new text. The chapter on foundations incorporates all the newer types and contains essential elements of recent developments in soil mechanics as they relate to foundations. Like treatment is found in other sections of the building field where progress has been rapid during the past decade. Written primarily as a text for students of civil engineering and architecture, this book should prove a valuable addition to the libraries of all architects. Engineers who have occasion to do work in the building field only infrequently will find the book helpful as a source of basic information.

Flow Problems

THE HYDRAULICS OF STEADY FLOW IN OPEN CHANNELS—By Sherman M. Woodward and Chesley J. Posey. 151 pp. John Wiley & Sons, New York; Chapman & Hall, London. $2.75.

In the expositions of elementary hydraulics that served as textbooks a few years ago many subjects were dismissed with a short paragraph, subjects that now are given whole chapters. Some of the more recent works, on the contrary, assume a reader's knowledge comprising nearly all of the older texts, and go on from that point to develop special treatment of some one or more phases of hydraulics. Such is the case with "Hydraulics of Steady Flow in Open Channels." After a short introduction and explanation of terms, the authors plunge directly into the various phases of flow with a constant value of Q. The theme of the text is the recognition of three major flow characteristics, at shooting, streaming and critical depths, with analysis of change from one to the other as well as continuing flow at any one of them.

The most common of flow problems—the determination of channel size to accommodate a given quantity—is discussed in terms of both Manning and Kutter, with tables of well-selected dimensions, cross-sections and gradations. The basic values of n are more explicit than is usually the case.

Treatments beyond the size and scope of the book are given subjects with which the authors have had extended personal contact. More than half the text is devoted to the hydraulic jump and to backwater curves. It is to be regretted that similar treatment was not given to other advanced material that may be more important to the practicing engineer. More extended text relating to flow through the many common constructions is desirable.

An excellent feature of the hydraulic jump discussion lies in the negative as well as the positive viewpoint. Many of the conditions under which the jump will not develop are

described. Too often has the impression been given that the jump must result when shooting water impinges upon a pool of still or streaming water.

Critical flow is introduced largely in terms of limiting conditions attendant on shooting and streaming flow. Critical flow exists at all brinks in open-channel flow, and it has great possibilities as a criterion for measurement and also for maximum capacity for a given available energy content. The reader is started along this most interesting road by discussion, formulas and tables.

Backwater curves are given more attention than usual. With the full development of our rivers, the best possible information is needed as to the upper limits of river level caused by any particular installation for power or navigation. Likewise the data on flow around bends are brought up to date. The great Unwin would be astonished at the present understanding of this tricky flow.

The three specialties to which the bulk of this book is devoted—hydraulic jump and attendant phenomena, the backwater curve and flood routing—are sufficient warrant for the practicing hydraulic engineer and the advanced student to add this book to his library. It is to be hoped that future editions may be brightened up with good photographs of the principal features discussed in the text.—*Reviewed by* FRED C. SCOBEY, *chairman, Hydraulics Division, American Society of Civil Engineers, Berkeley, Calif.*

Refuse Collection

REFUSE COLLECTION PRACTICE—Committee on Refuse Collection and Disposal, American Public Works Association, 1313 East 60th St., Chicago, Ill. November 1941. 659 pp., 221 illustrations, charts, tables. $5.00.

This volume is the first comprehensive treatise on refuse collection practice published since 1921, and it represents the results of almost two years of research by the American Public Works Association. It presents an analysis and appraisal of refuse-collection practice based on information secured from 190 cities of the United States and Canada. The 16 chapters of the book contain data on methods, operating experiences, administration, costs of refuse-collection operations from municipalities ranging in population from the very largest to those having but a few thousand inhabitants. Communities of 41 states and 7 provinces of Canada are included. Provisions of typical refuse-collection ordinances enacted by American cities are included in an appendix.

Stuart M. Weaver, executive assistant of the Board of Commissioners, Montclair, N. J., was chairman of the association's committee that carried out the study.

Miscellaneous Notes on Booklets and Reprints

THE TRANSPORTATION LOAD put on Michigan highways by the war effort is described in "The Transportation of Materials and Workers in War Industries in Michigan," issued by the Michigan State Highway Department, Lansing.

RAINFALLS OF 10 IN. OR MORE during 24 hours, in the United States, are analyzed by Prof. Stephen S. Visher of Indiana University in the December, 1941, issue of *Monthly Weather Review.* (Superintendent of Documents, Washington, D. C., price 20c.) Also included is a chart of the world's record rainfalls.

A LIMITED NUMBER of copies of a paper on the present status of cathodic protection of pipelines, presented at the second annual water conference of the civil engineering section of the Engineers' Society of Western Pennsylvania, are available to those having a real need for such information from the Underground Corrosion Section, National Bureau of Standards, Washington, D. C.

"ENGINEERING AS A CAREER" has been issued by the Engineers' Council for Professional Development (29 West 39th St., New York) to take the place of "Engineering: A Career —A Culture," which has been out of print for some time. The pamphlet is designed as an aid to high school students, and to the parents and teachers of students who are considering taking up engineering in college. Single copy, 10c.; 100 copies, $7.50. The E.C.P.D. also has issued a third edition of "Manual for the Guidance of Young Men Interested in Engineering Education and the Engineering Profession".

METHODS OF FRAMING TIMBER STRUCTURES using timber connectors are given in considerable detail in a pamphlet entitled "Fabricating Teco Timber Connector Structures" being distributed by the Timber Engineering Co., Washington, D. C.

TO HELP COUNTERACT the effect of the scarcity of rubber, the Goodyear Tire & Rubber Co., Akron, Ohio, has issued a pamphlet entitled "Truck Tire Engineering Service" which contains tips on how to improve the life expectancy of tires, also information on procedure for obtaining new truck tires or recapped or retreaded tires under rationing regulations.

New Engineering Books

ENGINEERING ECONOMIC ANALYSIS—By Clarence E. Bullinger. 359 pp. McGraw-Hill Book Co., New York & London. $3.50.

DESIGN HANDBOOK FOR PRACTICAL ENGINEERS—By Dr. Alois Cibulka. Clarke & Courts, Houston, Texas. Price $5.

HEATING VENTILATING AIR CONDITIONING GUIDE—Volume 20—1942. 1,160 pp. American Society of Heating and Ventilating Engineers, 51 Madison Avenue, New York. $5.

THE ROAD WE ARE TRAVELING—By Stuart Chase. 106 pp. Twentieth Century Fund, 330 W. 42nd St., New York. $1. *First of a series of six books to focus attention on post-war problems which is being published by the Twentieth Century Fund under the general title of "When The War Ends." Price for the series, $5.*

MODERN SANITARY ENGINEERING—By G. Eric Mitchell. 169 pp. Chemical Publishing Co., Brooklyn, N. Y. Price $5. *A British publication relating to house plumbing, drainage and ventilation.*

Reports and Pamphlets

A HISTORY OF SUSPENSION BRIDGES IN BIBLIOGRAPHICAL FORM—By A. A. Jakkula. A publication of the cooperative investigation of bridge types by the Public Roads Administration and the Agricultural and Mechanical College of Texas. Engineering Experiment Station Series No 57. Texas Engineering Experiment Station, College Station, Texas.

(Continued on p. 106)

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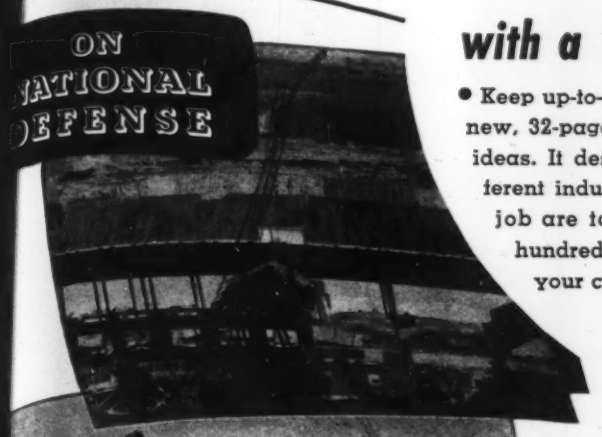
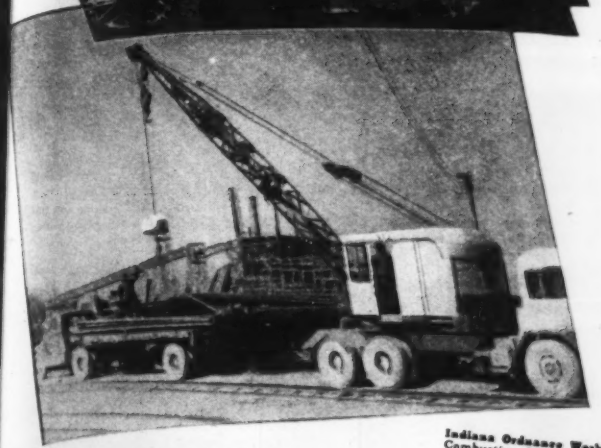
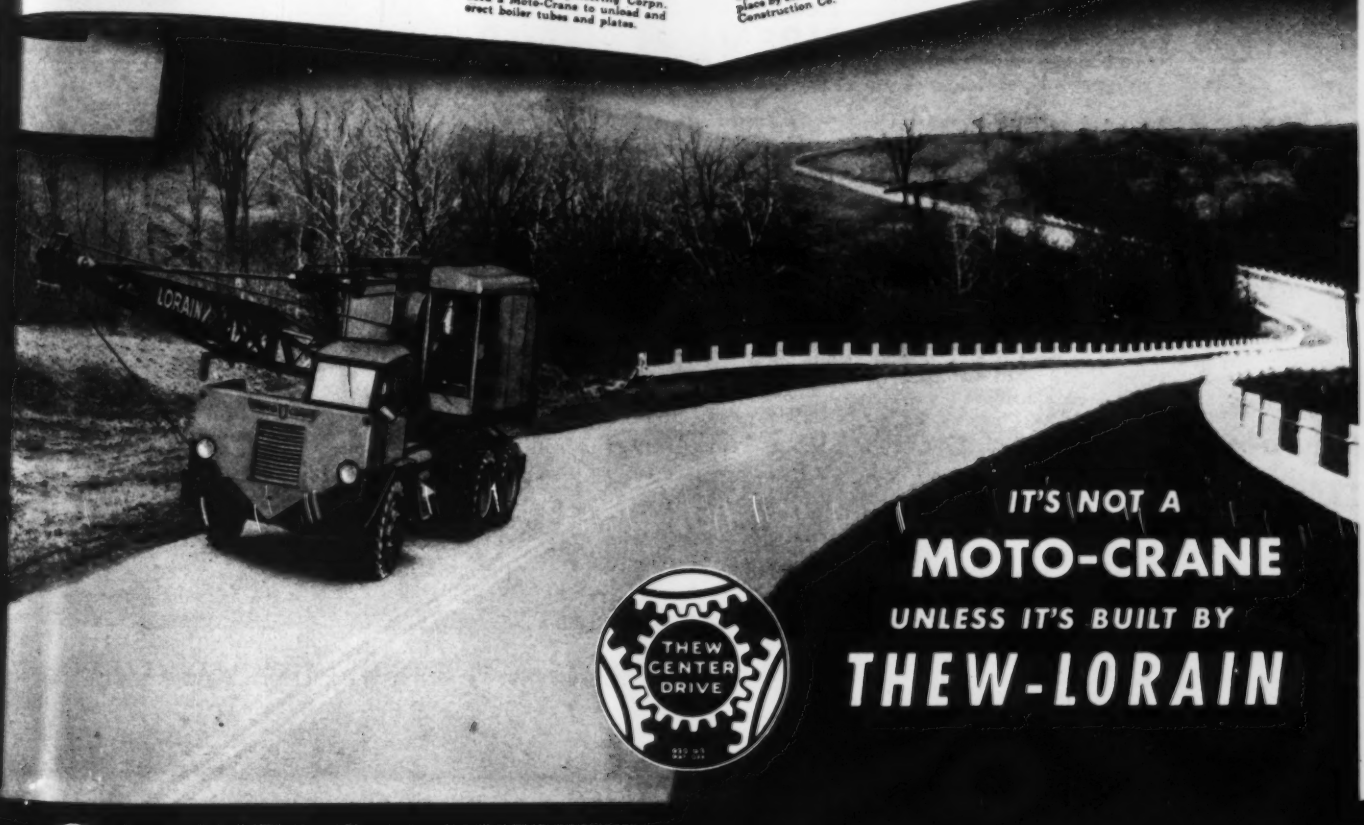




Indiana Ordnance Works, Ind. Combustion Engineering Corpn. used a Moto-Crane to unload and erect boiler tubes and plates.

St. Louis Ordnance Plant, Mo. New buildings in the Powder Storage Area shape up rapidly with concrete being swung into place by one of the 4 Moto-Cranes of Fruin Construction Co.



THEW CENTER DRIVE

IT'S NOT A
MOTO-CRANE
UNLESS IT'S BUILT BY
THEW-LORAIN

MATERIALS AND LABOR PRICES

Market quotations on construction materials and wage rates reported monthly by ENR correspondents

APRIL CONSTRUCTION material prices showed minor gains due largely to higher transportation costs; and increased labor rates were reported in four of the *ENR* twenty cities. Southern pine prices were up $1.00 to $3.00 in Atlanta; $1.00 higher on some sizes in Chicago; and up $1.00 in Philadelphia. Western pine and Douglas Fir climber $1.00 in Minneapolis. Railway ties increased in Philadelphia and St. Louis. Seattle base price on fir plywood is unchanged from March.

Minor increases were recorded in cement prices in Detroit and Kansas City. Ready-mixed concrete was up 10c. per cu. yd. in Atlanta, 25c. higher in Kansas City, but off 50c. in Minneapolis.

Common labor rates for heavy construction climbed 10c. per hour in Birmingham, and 5c. per hour in Cincinnati and New Orleans on both common labor on heavy construction and common labor on buildings.

Cincinnati bricklayers' rate increased 12½c. per hour, and structural ironworkers' wage rose 7½c. Hoisting engineers' hourly wage climbed in Cincinnati and Pittsburgh.

CEMENT, AGGREGATES, READY-MIXED CONCRETE—F.O.B. CITY

	PORTLAND CEMENT			SAND AND GRAVEL (Per ton, carload lots)			CRUSHED STONE (Per ton, carload lots)		CRUSHED SLAG (Per ton, carload lots, f.o.b. plant)		CONCRETE (Ready Mixed 1:2:4, 50 c.y. or more, delivered)
	Per bbl., carload lots, including 40c per bbl. for bags, cash discount not deducted. Cloth Bags [a]	Paper Bags	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	
Atlanta	$2.73	$2.48	$2.43	$1.75	$1.85	$1.95	$1.75	$1.85	$1.55	$1.65	$8.00
Baltimore	2.36	2.11	1.91	1.75‡	1.75‡	1.25‡	1.75‡	1.75‡	1.75‡	1.75‡	7.25
Birmingham	2.50	2.25	....	1.75	1.75	1.50	1.00	1.00	.90	1.15	5.80
Boston	2.75[b]	2.50[b]	2.30	1.40‡	1.40‡	1.00‡	1.40‡	1.40‡	....	....	7.25[m]
Chicago	2.60	2.35	2.20	2.00‡[d]	2.00‡[d]	2.00‡[d]	2.00‡[d]	2.00‡[d]	1.50‡	1.50‡	....
Cincinnati	2.31	2.06	1.81	1.20	1.20	1.10	1.80	1.80	....	....	6.60
Cleveland	2.39	2.14	....	1.60[i]	1.60[i]	1.55[i]	2.05[i]	2.05[i]	1.70[i]	1.70[i]	7.30[k]
Dallas	2.52	2.27	2.07	1.75[p]	2.00[p]	1.25[p]	1.60[p]	1.84[p]	....	....	6.20
Denver	3.08	2.88	....	1.20	1.40	.90	....	....	....	....	7.25
Detroit	2.40	2.15	1.95	1.50	1.60	1.10	2.25	2.25	2.00‡	2.00‡	6.50
Kansas City	2.58	2.33	2.18	1.85	2.30	1.00	1.91	1.91	....	....	7.80[n]
Los Angeles	2.80[o]	2.20[o]	....	1.20	1.20	1.15	1.20[f]	1.20[f]	....	....	6.35
Minneapolis	2.90	2.65	....	1.00[h]	1.00[h]	.25[h]	1.00[h]	1.00[h]	....	....	7.35[f]
Montreal	....	1.95[r,s]	1.79[r,s]	....	....	1.25‡[t]	.85‡[d,t]	1.00‡[d,t]	....	....	6.45[s,t]
New Orleans	2.41	2.16	1.96	1.50	1.50	1.25	....	....	....	....	7.25
New York	2.55‡	2.30‡	....	1.60[d,e]	1.60[d,e]	.90[d,e]	1.70[d,e]	1.80[d,e]	....	....	6.75
Philadelphia	2.31	2.07	1.87	1.55‡	1.65‡	1.20‡	1.90	1.95	1.10	1.10	8.20[k]
Pittsburgh	2.44	2.19	1.99	1.40‡	1.40‡	1.70‡	2.25‡	2.25‡	1.50	1.50	8.25
St. Louis	2.80	2.52	....	1.50‡	1.50‡	1.25/1.50‡	1.10[h]	1.10[h]	.75[g]	.75[g]	8.00
San Francisco	....[u]	2.21	1.81	1.36	1.36	1.36	1.46	1.46	....	....	7.55
Seattle	2.95[o]	2.70[o]	....	1.00[o]	1.00[o]	1.00[o]	2.00[o]	2.00[o]	....	....	7.25

‡ Delivered. [a] 10c. allowed for each returnable bag. [b] 10c. per bbl. off for cash. [c] Plus municipal tax. [d] Per cu. yd. [e] Barge lots alongside docks. [f] Crushed granite. [g] F.o.b. Granite City, Ill. [h] F.o.b. plant. [i] Within three miles of Public Square. [j] 5% discount for cash. [k] Discount 35c. 500 to 2000; 70c. 2000 to 5000; 95c. over 5000. [l] Up to 200cu. yd. [m] 50c. off for cash. [n] 25 c.y. or more. [o] 2% off for cash. [p] 10c. per ton off, cash 15 days. [r] 10c. per bbl. off, cash 20 days. [s] 8% sales tax included. [t] 8% sales tax not included. [u] Price withdrawn. [v] 20c. per bbl. discount; 20c. allowed for returnable cloth bag.

CASH DISCOUNTS CEMENT to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount 10c. per bbl. for payment within 15 days of date of invoice. Subject discount 10c per bbl. 20 days in Montreal.

CURRENT MAXIMUM PRICES RECEIVED AT CEMENT MILL

Charge for bags not included. For cloth bags, add 40c. per bbl.; 10c. refund allowed for each returnable bag; for paper bags add 15c. per bbl., not refundable.

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Buffington, Ind.	$1.70	$1.65	Ironton, Ohio	$1.60	$1.55	Richard City, Tenn.	$1.80	$1.75
Dallas, Tex. (Inc. 10c. tax)	1.85	1.80	Limedale, Ind.	1.70	1.65	Steelton, Minn.	1.80	1.75
Hannibal, Mo.	1.70	1.65	Norfolk, Va.	1.75	1.70	Universal, Pa.	1.65	1.60
Hudson, N. Y.	1.75	1.70	Northampton, Pa.	1.55	1.50	Waco, Tex (Plus 10c. tax in Tex.)	1.75	1.70
Independence, Kans.	1.70	1.65	North Birmingham, Ala.	1.70	1.65	Montreal (8% sales tax incl.)	1.68	1.67

PAVING BRICK, BLOCKS, ASPHALT, ROAD OILS—F.O.B. CITY

	PAVING BRICKS AND BLOCKS			PAVING ASPHALT (Per ton, less than 80 penetration)		ASPHALT BINDERS—FLUXES (Per gal., 80-300 penetration)		CUTBACK ASPHALT (Per ton)		ROAD OILS (Per gal.)	ASPHALT EMULSION (Quick-breaking) (Per gal.)	
	Granite per M. lots of 50,000 4x4x8 in.	Brick per M. 3¾x4x8½ in. carload lots	Wood per sq. yd. 3½ in. 16-lb. treat	Tank car	Drums	Tank car	Drums	Tank car	Drums	Tank car	Tank car	Drums
Atlanta	$73.00	$39.35	$2.25	$18.40[e]	$24.62[e]	$0.0787[e]	$0.1309[e]	$0.0826[h,e]	$0.1348[h]	$0.0676[e]	$0.0826	$0.1348
Baltimore	145.00‡	45.00‡	2.90	14.00*	20.00*	.06*	.09*	.065[h]*	.115[h]*	.....	.....	.....
Birmingham	.....	32.00[j]	....	18.20†	23.20†	.0747†	.1047†	.0834[h]†	.1484[h]†	.065†	.09†	.12†
Boston	80.00	50.00	3.75	14.00	20.00	.06	.09	.065[h]	.115[h]	.065	.09‡	.12‡
Chicago	150.00	50.00	2.00[d]	14.50	20.00	13.00[g]	18.50[g]	.065[h]	.11[h]	.06	.10	.14
Cincinnati	112.00	37.50	....	16.00	20.00†	.08	.....	11.80	.....	.07	.....	.085
Cleveland	110.00	38.50	2.25	20.00	25.00	.09	.155	.105[h]	15.00	.07	.11	.15
Dallas	.....	36.00	....	13.25	20.30	.06	.103	16.00	24.80	.055	.05/.07	.07/.09
Denver	.....	27.50	....	....	.....	.....	.....	.....	.....	.....	.....	.....
Detroit	.....	37.50	....	15.10[f]	22.60[f]	.0725	.1262	15.10	21.10	.067	.0725	.1262
Kansas City	.....	40.00	....	18.50	23.50	.077	.1075	.077[h]	.107[h]	.057	.11	.15
Los Angeles	.....	50.00	....	7.00[b]	16.00	7.00[b,g]	16.00[b,g]	6.00[b]	.....	.025	.0525	.1125
Minneapolis	.....	.....	1.87[d]	21.20	27.70	.....	.126	.....	32.64	.....	.....	.....
Montreal	.....	.....	....	16.60[k]	24.25[k]	.115[k]	.1485[k]	.115[h,k]	.135[h,k]	.08[k]	.135[k]	.188[k]
New Orleans	.....	.....	....	14.00[a]	19.00[a]	.055	.085	.06[h]	.09[h]	.....	.078	.....
New York	.....	.....	....	15.00*	21.00*	.06	.09*	.065[h]*	.115[h]*	.....	.0725	.1225
Philadelphia	130.00	49.50	3.80	14.00	22.00*	.055	.12*	.065[h]	.13[h]*	.055	.065	.13*
Pittsburgh	135.00	38.75	....	.....	.....	.....	.....	.....	.....	.....	.....	.....
St. Louis	.....	37.00	....	16.00	21.00	15.00[g]	21.00[g]	.0625[h]	.1125[h]	.0475	.095	.1275
San Francisco	.....	70.00	....	9.50[m]	18.00[m]	9.50[g,m]	18.00[g,m]	10.00[m]	17.50[m]	9.50[g,m]	.0525[m]	.1125[m]
Seattle	.....	60.00[c]	....	17.90	25.35	.....	25.10[g]	10.00	.....	9.50[i]	.0575[i]	.1308[i]

‡ Delivered. [a] F.o.b. Baton Rouge. [b] Delivered to purchaser's warehouse. [c] 3¾x4x8½ in. [d] 2½ in. 12-lb. treatment. [e] Local reduction due to 20% reduction intra-state class freight rates, only Georgia affected. [f] Mexican. [g] Per ton. [h] Per gallon. [i] F.o.b. Martinez. [j] 3x3½x8½ in. [k] tax included. * December asphalt prices; none later available. †February prices; none later available. [m] March prices latest available.

Limestone To Lick The Aggressors! World's Largest Producers Use Timken Bits 100% To Get It Out.

Essential to steel production, construction and agriculture, limestone is a vital material in the Victory production program. Two limestone quarries (shown here) of the world's largest producers, located in northern Ohio, have used Timken Rock Bits for several years.

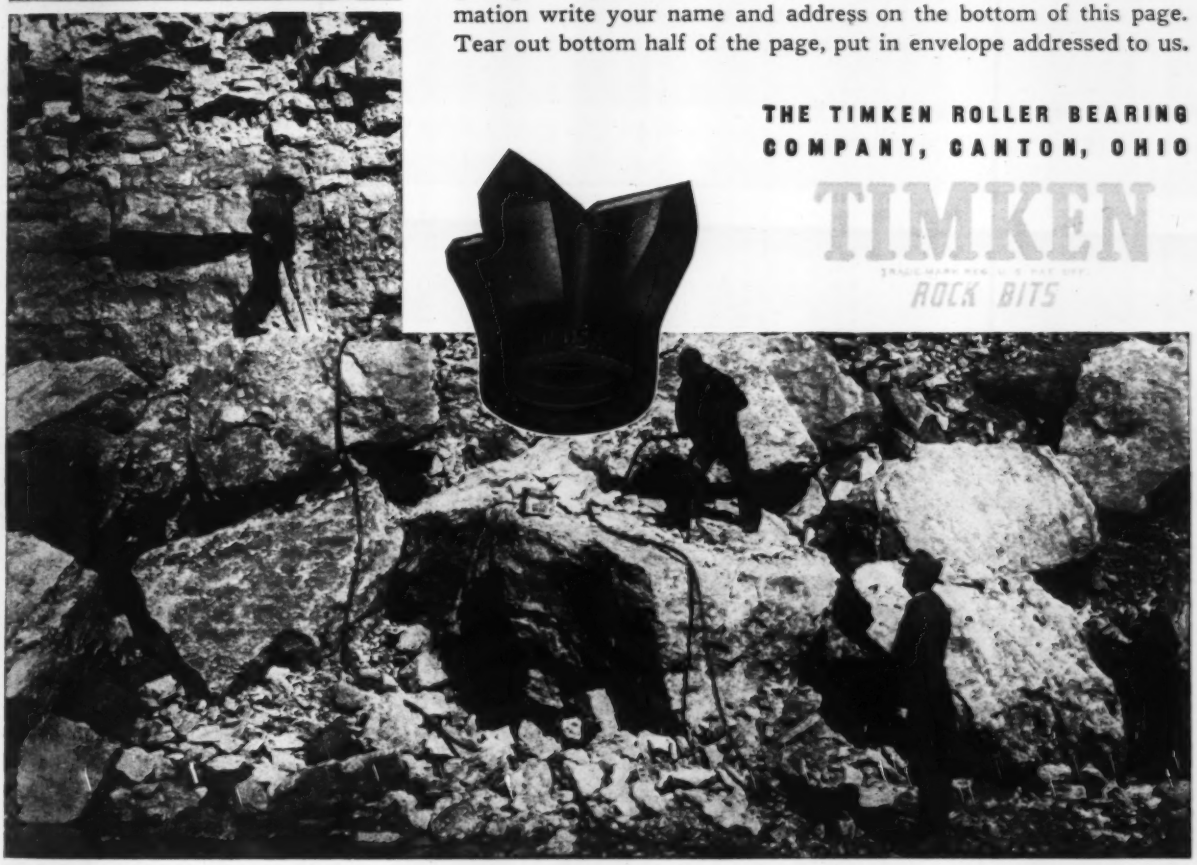
If the advantages of Timken Bits were significant enough for these operators to adopt them in peace time it is certain that these advantages have been greatly magnified by the war.

If you are not using Timken Bits you will never gain more by adopting them than you can today. And every day you wait before investigating their possibilities costs you money. To request further information write your name and address on the bottom of this page. Tear out bottom half of the page, put in envelope addressed to us.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN

ROCK BITS



IRON AND STEEL PRODUCTS — BASE MILL PRICES

	STRUCT. SHAPES-PLATE	REINF. BARS ¼-in. billet *b*	RIVETS ½-in. structural	WIRE NAILS Base *d*	SHEET PILING Base	STEEL RAILS Per Gross Ton: Standard	Light	Re-rolled	TRACK SUPPLIES: Angle Bars	Std. Spikes *c*	Tie Plates *c*	Track Bolts
Birmingham	$2.10	$2.15	$3.75	$2.55	.....	$40.00	$40.00	$39.00	$2.70	$3.00	$2.15	$4.75
Chicago	2.10	2.15	3.75	2.55	$2.40	40.00	40.00	39.00	2.70	3.00	2.15	4.75
Pittsburgh	2.10	2.15	3.75	2.55	2.40	40.00	40.00	39.00	2.70	3.00	2.15	4.75
Buffalo	2.10	2.15	.....	.....	2.40	.....	.....	.....	.....	.....	2.15	.....
Cleveland	2.10	2.15	3.75	2.55	.....	.....	.....	.....	.....	.....	.....	.....
Youngstown	.....	2.15	.....	.....	.....	.....	.....	.....	.....	3.00	.....	.....
Detroit	.....	2.25‡	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Gulf ports	2.45*a*	2.50*a*	.....	.....	2.85*a*	.....	.....	.....	.....	.....	.....	.....
Pacific ports	2.75*a*	2.80*a*	.....	.....	2.95*a*	.....	.....	.....	.....	.....	2.30	.....

‡ Delivered. *a* F.o.b. cars dock. *b* Rail steel same as billet prices. *c* Other basing points include Portsmouth, O., Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., and Pacific coast ports, on tie plates, alone, Steelton, Pa., on spikes alone, Lebanon, Pa., Richmond, Va. *d* Add switching charge $18 per c.l.

IRON AND STEEL PRODUCTS — F.O.B. WAREHOUSE, PER 100 LB., BASE PRICE

	STRUCTURAL SHAPES Per 100 lb. base price	REINFORCING BARS[a] Per 100 lb., ¼ in., base price: 15 tons or over *b* New billet	Rail steel	Add Switch	$/cwt. for Del.	EXPANDED METAL LATH Per 100 sq.yd., carload lots: Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	WELDED FABRIC REINFORCING Per 100 s.f., carload lots: 4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6x6 in. No. 6 & 6 wires Per sq. yd.	SHEET PILING Per 100 lb. base price
Atlanta	$2.34	$2.39	$2.39	.02½	.10	$21.06	$23.00	$1.82	$1.35	$0.1719	$3.04
Baltimore	3.70	2.90	2.75	.....	.10	29.00	30.00	1.70	1.27	.1611	3.00
Birmingham	2.10*a*	2.15	2.15	.02½	.10	19.00	21.50	1.80	1.34	.1704	.....
Boston	3.85	3.51	3.36	$20 C.L.	.10	18.50	29.50	1.76	1.31	.1658	2.70
Chicago	2.10*a*	2.15	2.15	.03	.05	21.50	23.50	1.67	1.25	.1575	2.40
Cincinnati	3.68	2.53*cd*	2.53*cd*	.....	.05	19.50	21.50	1.66	1.25	.1566	.....
Cleveland	2.10*a*	2.15	2.15	.02½	.10	19.50	21.50	1.66	1.25	.1566	.....
Dallas	6.00	3.40	3.40	.....	.....	24.50	26.50	1.93	1.42	.1827	.....
Denver	4.35	3.95	3.80	.....	.....	26.50	28.50	1.97	1.45	.1863	.....
Detroit	3.65‡	2.34	2.24	.....	.10	22.00	24.00	1.68	1.26	.1584	2.66
Kansas City	4.00	2.64*cd*	2.64*cd*	.0	.05	19.50	23.50	1.78	1.33	.1683	2.86
Los Angeles	3.65*f*	2.25	2.10	.02½	.05	23.00	27.50	1.93	1.42	.1827	3.65
Minneapolis	3.80‡	2.50*c*	2.50*c*	.0	.10	25.00	27.00	1.80	1.34	.1701	2.75*d*
Montreal	3.90*i*	2.65*i*	2.55*i*	.....	.....	26.00*hi*	33.00*hi*	2.58*i*	3.22*i*	.2644	.....
New Orleans	4.40	2.52	2.52	.05	.10	21.50	23.50	1.82	1.35	.1719	2.875
New York	3.75	2.76*e*	2.76*e*	.....	.15	17.50	19.50	1.76	1.33	.1663	2.74
Philadelphia	3.65	3.85	....	.....	.....	19.50	21.50	1.71	1.28	.1611	2.74
Pittsburgh	2.10*a*	2.15	2.15	.02½	.10	23.00	26.50	1.59	1.20	.1503	2.40
St. Louis	3.69	2.39	2.39	.0	.05	28.00	34.00	1.69	1.27	.1602	2.70
San Francisco	4.25	2.65	2.50	.02½	.10	21.00	24.50	1.93	1.42	.1827	3.85
Seattle	2.75*e*	2.50*e*	.....	.....	.....	34.50	38.50	1.93	1.42	.1827	2.95*gj*

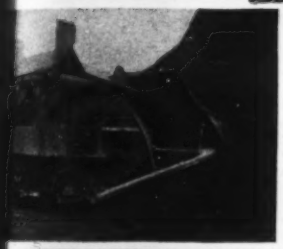
‡ Delivered. *a* Mill prices. *b* 5–15 tons add 15c. 1–5 tons, add 25c. Less than 1 ton, add 50c. *c* 20 tons or over Base. *d* Mill price plus freight. *e* F.o.b. dock. *f* Includes delivery in free delivery zone. *g* Less than 1 ton, add 25c.; 1 to 5 tons add 10c. High scrap steel prices cut former 15c. differences between new billet and rail steel in many mills. *h* List price. *i* Plus Dominion and Province sales tax *j* Increase due to all rail shipment route.

PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

	C. I. PIPE Per net ton f.o.b. 6 in. to 24 in.*a*	VITRIFIED SEWER PIPE: Per foot, std. 8 in., s.s.	delivered std. 12 in., s.s.	ASTM 24 in.,	C13–35 36 in.,	CLAY DRAIN TILE Per 1,000 ft., carload lots, f.o.b.: 6 in.	8 in.	CONCRETE SEWER PIPE Per ft., delivered; ASTM 12 in.	C 14–35 24 in.	WROUGHT STEEL PIPE Full standard weight, *h*: 1 to 3 in., Black %	Galv. %	Butt Weld 3½ to 6 in.: Black %	Galv. %	Lap Weld
Atlanta	$49.40	$0.26*b*	$0.468*bc*	$1.8525	$4.68*c*	$85.00	$128.00	$0.45	$1.642	48.2	54.2	59.7	51.2	
Baltimore	52.80	.35	.60	2.50	7.10	150.00	200.00	.45	1.60	65.5	57.5	63.0	54.5	
Birmingham	45.00	.275	.495	1.95	5.50	100.00	220.00	.40	1.60	62.2	54.2	59.7	51.2	
Boston	55.00	.32	.62	2.10	....	135.00	.....	.65	....	64.1	56.1	61.6	53.1	
Chicago	53.80	.28	.54	2.25	6.25	100.00‡	150.00‡	.38	1.50	67.0	59.0	63.5	55.0	
Cincinnati	52.70	.231	.4455	1.80	5.125	105.00	170.00	.60	1.70	65.9	57.9	63.4	54.9	
Cleveland	54.24	.203	.3915	1.665	5.125	81.00	125.00	.38	1.60	67.8	59.8	65.3	56.8	
Dallas	58.20	.305	.549	2.25	5.00	90.00	110.00	.46	1.57	59.9	51.9	57.3	48.3	
Denver	60.60	.24†	.52†	2.16†	.....	130.00	240.00	....	....	58.4	50.4	55.7	47.2	
Detroit	54.24	.245	.4725	1.935	4.60	82.50	131.25	.35	1.50	66.3	58.3	63.8	55.3	
Kansas City	55.12	.315	.59	2.20	5.86	140.00	260.00	.45	1.60	62.9	54.9	60.0	51.5	
Los Angeles	55.00	.282†	.508†	2.034†	5.085†	115.50	192.50	1.00	2.00	59.6	51.6	57.0	48.6	
Minneapolis	59.00	.275†	.495†	1.98†	5.14†	.....	.....	.77	1.98	64.2	56.2	60.7	52.2	
Montreal	60.00	.55	.90	3.68	5.95*a*	135.00‡*l*	260.00‡*l*	.48*m*	1.92*m*	....	.....	.....	....	
New Orleans	51.38	.26	.48	1.69	.....	150.00	220.00	.37	2.10	62.4	54.4	58.8	50.3	
New York	52.20	.455	.8775	2.925	7.65	.....	.....	.50	1.20	64.9	56.8	62.4	53.9*i*	
Philadelphia	.....	.28	.54	2.30	6.75	120.00	200.00	.45	1.75	56.4	42.6	53.3	38.9	
Pittsburgh	55.60	.245†	.4725†	1.845†	5.4325	97.80	154.20	.85*g*	2.00*g*	68.5*i*	57.5*i*	66.0*i*	54.5	
St. Louis	52.48	.28	.504	2.016	4.50	85.00	220.00	1.10*f*	1.80*k*	56.4	42.6	52.5	38.4	
San Francisco	58.00	.3625*d*	.6525*d*	2.61	6.52	115.50	192.50	.54	2.75	45.0	31.0	47.0	34.5	
Seattle	55.35	.375	.675	2.70	6.75	84.00	187.50	.45*f*	1.40*f*	.....	.....	.....	....	

‡ Delivered. † F.o.b. *a* B. & S. class B and heavier, C/L lots, 200 tons and over Burlington, N.J. (base) $49.00. Based on existing freight rates; subject to rate change. Gas pipe and class A, $3 per ton additional. 4 in., $3 per ton additional. 30 in. and larger usually $2 per ton less. *b* Double strength. *c* List to dealer. *d* List. *e* 30-inch. *f* Less 5% for cash. *g* Culvert pipe. *h* Discounts from standard list consumers carload prices, except Pittsburgh prices are f.o.b. mill. Base price $200 per net ton. List prices per ft.: ¾ in., 8½c.; 1 in., 11½c.; 1 in., 17c.; 2 in., 37c.; 2½ in., 58½c.; 3 in., 76½c.; 4 in., $1.09; 6 in., $1.92. *i* Applies also at Lorain, Ohio, mills. Chicago delivered base is 2½ points less on butt, 1½ on lap. Freight is figured from Pittsburgh, Lorain, O., Chicago Dist. Billing is from point producing lowest price at destination. WROUGHT IRON PIPE: Base price and list prices per ft. same as wrought steel pipe. Discount for Pittsburgh base: Butt-weld—1 in. and 1¼ in. black 34, galv. 16; 1½ in. black 38, galv. 18½; 2 in. black 37½, galv. 18. Lapweld—2½ in. to 3½ in black 31½, galv. 14½ in.; 4½ in. to 8 in. black, 32½ galv. 17. *j* Reinforced; spec. C 76-37. *k* Reinforced; spec. C 75-37. *l* Plus sales tax. *m* Tax included.

ON Essential FRONTS

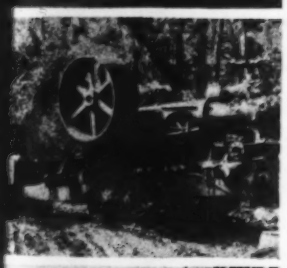


Airports

A fleet of Athey Trailers pulled by "Caterpillar" Diesels works day and night on this Penn. landing field.

Iron Ore

This Athey MobiLoader loads ore on the Mesabi Iron range in Minnesota.



Oil

America's oil resources are vital for victory. An Athey Trailer provides sure-footing under a giant mud pump on its way to another well in this Louisiana field.

Sugar

A precious load of sugar leaves this Florida plantation on its way to the loading platform. The dependable transportation of Athey Tracks is essential to many industries.

Wood

Throughout the great lumber belt of the West and Northwest, logging production is increased with Athey Logging Cruiser Wheels.

ATHEY EQUIPMENT
Answers Wartime Needs

Sugar – iron – lumber – airports. Yesterday these were words of peacetime commerce. But today they've acquired a vivid meaning — a meaning interwoven with the very welfare and security of our nation.

The mighty task of producing essential materials for victory has been undertaken with typical American determination. And as our forces fight on world wide fronts, so do men and machines work in the battle of production at home.

Athey Forged-Trak equipment has a wide diversity of important uses. Wherever there are tough hauling problems, wherever bad footing, big loads or adverse weather have to be licked, you'll find Athey Trailers. They're speeding output on vital war earthmoving jobs, hauling huge sugar trains from swampy plantations, transporting heavy oilfield equipment and tools, increasing the flow of iron ore, wheeling giant logs from the woods — providing sure-footed hauling units for many critical war-time operations.

Athey Trailers, Wagons and MobiLoaders are "in the fight" on many fronts all over the world. *When you experience delays in delivery, it is because the armed forces of Victory have first call on Athey production.* Athey Truss Wheel Co., 5631 W. 65th Street, Chicago, Illinois.

ATHEY

LUMBER, TIMBER, PLYWOOD—PER M FT., B.M., CARLOAD LOTS F.O.B.

	SHORT LEAF YELLOW PINE AND DOUGLAS FIR — All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. (Prices in Bold Face) *All Fir planks No. 2 common, Fir timber is No. 1 common. Lengths up to 20 ft. (Prices in italics)*								LONG LEAF Y. P. Merchantable grade up to 20 ft.		PLYWOOD Rail freight increment (See note for base price)
	1x6 S4S	1x8 S4S	2x4 S4S	2x6 S4S	2x8 S4S	2x10 S4S	3x12 Rgh	6x12 Rgh	12x12 Rgh	2x12 Rgh	12x12 Rgh	⅜" / ¼"
Atlanta	**$28.00**	**$28.00**	**$29.00**	**$27.00**	**$28.00**	**$29.50**	**$44.00**	.....	.....	$60.00	$70.00	$17.75 / $21.60
Baltimore	**39.00**	**40.00**	**40.00**	**38.00**	**38.00**	**40.00**	**56.00**	.....	.....	89.00	94.00	17.35*g* / 21.15*g*
	44.00	*44.50*	*45.00*	*45.00*	*45.00*	*47.00*	*66.00*	*$59.00*	*$59.00*	.....	.....	..... / .....
Birmingham	**34.50**	**34.50**	**32.00**	**32.00**	**32.00**	**34.00**	**53.00**	**53.00**	**56.00**	.....	.....	16.25 / 19.85
‡	37.50	37.50	37.00	37.00	37.00	43.00	65.00	.....	.....	67.50	70.00	..... / .....
Boston	**38.00**[2]	**38.00**[2]	**50.00**[2]	**50.00**	**75.00**[1]	**85.00**[1]	**95.00**[1]	.....	.....	95.00	105.00	17.35*g* / 21.15*g*
	38.00	*38.00*	*50.00*	*50.00*	*50.00*	*50.00*	*75.00*	*75.00*	*75.00*	.....	.....	..... / .....
Chicago	**43.00**	**44.00**	**43.00**	**43.00**	**44.00**	**46.00**	**53.00**	.....	.....	100.00	100.00	13.80 / 16.80
	46.00	*46.00*	*46.00*	*44.00*	*46.00*	*48.00*	*60.00*	*55.00*	*55.00*	.....	.....	..... / .....
Cincinnati	**41.00**	**42.50**	**39.00**	**40.50**	**42.00**	**43.00**	**53.00**	.....	.....	65.00	68.00	16.25 / 19.85
	.....	.....	.....	.....	.....	.....	*66.50*	*65.50*	*65.50*	.....	.....	..... / .....
Cleveland	**42.50**	**42.50**	**41.50**	**43.50**	**45.00**	**48.00**	**53.00**	53.00	53.00	90.00	90.00	16.70 / 20.40
Dallas *e*	**39.50**	**40.50**	**39.50**	**38.00**	**38.50**	**39.50**	**53.00**	**53.00**	**53.00**	78.00	83.00	13.90 / 16.95
Denver ‡	54.00[4]	52.00[4]	55.00[4]	55.00[4]	55.00[4]	56.00[4]	59.00[4]	*73.00*	*79.00*	.....	.....	9.90 / 12.05
Detroit	**46.00**	**46.00**	**46.00**	**46.00**	**46.00**	**48.00**	**53.00**	.....	.....	53.00	61.50	16.25 / 19.85
	.....	.....	.....	.....	.....	*51.50*	*64.00*	*60.00*	*60.00*	.....	.....	..... / .....
Kansas City	**42.50**	**45.00**	**42.00**	**42.00**	**42.00**	**45.00**	**57.50**	.....	.....	70.00	75.00	12.25 / 14.95
	47.50	*47.50*	*47.50*	*47.50*	*47.50*	*50.00*	*57.50*	*75.00*	*75.00*	.....	.....	..... / .....
Los Angeles *a*	*55.00*	*55.00*	*53.00*	*53.00*	*51.00*	*51.00*	*57.00*	*65.00*	*65.00*	.....	.....	9.35*gh* / 11.35*gh*
Minneapolis ‡*b*	49.00[9]	49.00[9]	.....	.....	.....	.....	.....	.....	.....	.....	.....	12.05 / 14.70
‡	*53.00*	*53.00*	*53.00*	*52.00*	*52.00*	*53.00*	*69.00*	*61.00*	*61.00*	.....	.....	..... / .....
Montreal †[7]	*43.00*	*46.00*	*42.00*	*46.00*	*47.00*	*54.00*	.....	.....	.....	200.00	200.00	..... / .....
	42.25	*42.25*	*42.00*	*44.00*	*44.00*	*46.75*	*50.25*	*50.25*	*50.25*	.....	.....	..... / .....
New Orleans	**31.50**	**31.50**	**33.75**	**31.75**	**34.00**	**35.00**	**48.00**	.....	.....	69.00	69.00	13.90 / 16.93
	31.00	*31.00*	*33.00*	*31.00*	*54.00*	*52.00*	*53.00*	.....	.....	.....	.....	..... / .....
New York ‡	**46.00**	**47.00**	**46.00**	**47.00**	**48.00**	**49.00**	**59.00**	.....	.....	115.00*f*	125.00*f*	17.35*g* / 21.15*g*
‡	.....	.....	*62.00*	*62.00*	*62.00*	*62.00*	*65.00*	*72.50*	*72.50*	.....	.....	..... / .....
Philadelphia	**38.00**	**39.00**	**38.00**	**38.00**	**39.00**	**42.00**	**44.00**	.....	.....	70.00	75.00	17.35*g* / 21.15*g*
	47.00	*47.00*	*47.00*	*47.00*	*46.50*	*48.25*	*56.00*	*56.00*	*56.00*	.....	.....	..... / .....
Pittsburgh	**50.80**	**53.20**	**62.75**	**55.00**	**60.85**	**62.50**	**76.25**	.....	.....	.....	.....	17.00 / 20.70
	69.20	*68.10*	*66.10*	*65.30*	*65.20*	*66.65*	*88.75*	*88.75*	*88.75*	.....	.....	..... / .....
St. Louis ‡*c*	**45.00**	**46.50**	**44.50**	**42.50**	**43.50**	**45.00**	**59.00**	*67.50*	*67.50*	78.00	66.00	13.90 / 16.95
San Francisco *d*	*35.50*	*35.50*	*38.00*	*38.00*	*37.50*	*37.50*	*43.00*	*43.00*	*43.00*	.....	.....	7.30*g* / 8.90*g*
Seattle	*35.00*	*35.00*	*35.00*	*35.00*	*35.00*	*35.00*	*40.00*	*40.00*	*40.00*	.....	.....	0.00 / 0.00

Bold Face type, Southern Pine. *Italics, Douglas Fir.* [1] Long leaf. [2] Roofers' N. C. Pine. [3] Spruce. [4] Native. [5] Western Pine, No. 3 Common. [7] Spruce. [9] Norway Pine. ‡ Delivered. *a* Yard prices. *b* Contractors discount in Minneapolis and St. Paul discontinued May 21, 1938. *c* 5M ft. or less. *d* F.o.b. cars San Francisco freight rate. *e* 10% discount taken off. *f* Up to 18 ft. † Plus sales tax.

NOTE: Special concrete form grade Fir Plywood, 4' by 8' panels, 5-ply, sanded 2 sides, water resistant glue, carload lots, delivered per 1,000 sq. ft. surface. Seattle base price on ⅝", $86.50; on ¾", $95.30; price includes oiling and sealing charges. For other centers add rail freight increment from table or proper size. For resin dipped treatment, add $10.50 per M. *g* Lower rate by water shipment. *h* 50,000 lb. minimum.

GLASS, EXPLOSIVES, CHEMICALS

	WINDOW GLASS — Discounts from jobbers list, Aug. 15, 1938, Single or Double Thickness		EXPLOSIVES — Per lb. 40% Ammonia Gelatin in 50-lb. cases delivered in 200 lb. lots*
	A quality	B quality	
Atlanta	75%	75%	$0.15
Baltimore	79%	80%	.15
Birmingham	76%	76%	.105
Boston	77%	78%	.15
Chicago	79%	79%	.15
Cincinnati	77%	77%	.15
Cleveland	77%	77%	.19
Dallas	78%	78%	.1625
Denver	76%	76%	.155*e*
Detroit	77–10%	77–10%	.15
Kansas City	76–10%	76–10%	.155
Los Angeles	86%*d*	88%*d*	.1575
Minneapolis	76%	76%	.155
Montreal	40–5%‡	47%‡	.1675†
New Orleans	70%	75%	.16
New York	81%	82%	.22*f*
Philadelphia	78%	79%	.15
Pittsburgh	79%	79%	.1225
St. Louis	76–10%	76–10%	155
San Francisco	78%	80%	.155
Seattle	75%	76%	.1575†

Price of 60% Ammonia Gelatin is $0.01 per lb. higher than 40%

a Disc. from list Sept. 1939. *b* Also less 6% tax exemption. *d* Discount from jobbers' list Sept. 15, 1928. ‡ Plus sales tax.

* Urban prices influenced by service charges or local storage and delivery regulations, do not consistently reflect quantity prices in less congested areas. *e* F.o.b. Louviers, Colo. *f* In boroughs of Kings, Queens and Richmond, and in Manhattan south of Canal Street, add delivery charge of $6.00 per trip. † F.o.b.

40% Ammonia Gelatin price ranges in other than urban areas, per lb. (except Seismograph Grades)

	C/L 20,000 lb. net	Tons	200 lb. lots
E. of the Miss., except Fla. and Me.	$0.105	$0.13	$0.15
W. of Miss. to Rocky Mtn. States, Fla. and Maine	.11 –.1175	.135 –.1475	.155 –.1675
Rocky Mtn. States	.11 –.1225	.135 –.1525‡	.155 –.1725‡
Pacific N. W. States	.1075–.12	.1375–.15	1575–.17
Pacific S. W. States	.1050–.1125	.135 –.1425	.155 –.1625

‡F.o.b. Louviers, Colo., or Butte, Mont.

PILES, TIES—F.O.B.

PILES

Prices per linear foot, pine, with bark on, f.o.b. New York; delivered from barge 1½ to 2c. per ft. additional:

Dimensions	Points	Length	Short Barge	Leaf Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.23	$0.26
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.26	.28
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.27	.29
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.28	.29
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.31	.33
14 in.—2 ft. from butt	5 in.	80 to 85 ft.	.40	.44
14 in.—2 ft. from butt *	5 in.	85 to 89 ft.	.45	.482

RAILWAY TIES

Prices f.o.b., per tie for carload lots:		6"x8"x8' Untr.	6"x8"x8' Tr.	7"x9"x8'6" Untr.	7"x9"x8'6" Tr.
Boston	Oak	$1.30	....	$1.80	....
	Pine	1.60	$2.40*a*	2.40	$3.40*a*
New York	S. L. Sap Pine	1.30/1.40	2.35	1.60	2.60
	Mixed Oak	1.55	2.35	2.00	2.95
Birmingham	White Oak	1.00	1.60*a*	1.30	2.25*a*
	Southern Pine	....	....	....	....
Chicago	Red Oak	....	2.05*a*	....	2.70*a*
	Southern Pine	....	....	....	....
Los Angeles	Douglas Fir	1.10	1.75*a*	1.60	2.50*a*
Philadelphia	Red Oak	....	2.10*a*	....	3.25*a*
St. Louis	White Oak	1.65	....	1.90	....
	Red Oak	1.55	2.15*a*	1.90	2.70*a*
	Sap Pine or Cypress	1.45	....	1.80	....
San Francisco	Douglas Fir	1.25*bef*	....	....	3.00*caf*
Montreal	Birch or Maple	.85	....†	.95	....†

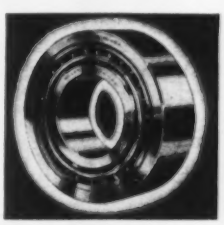
Tr.—Treated; Untr.—Untreated. *a* Creosoted. *b* 6" x 8" x 8'6". *c* Empty cell. *d* Zinc. *e* Green. *f* At ships tackle. † Out of market.

CHEMICALS

Water, sewage treatment, road work, f.o.b. carlots, New York

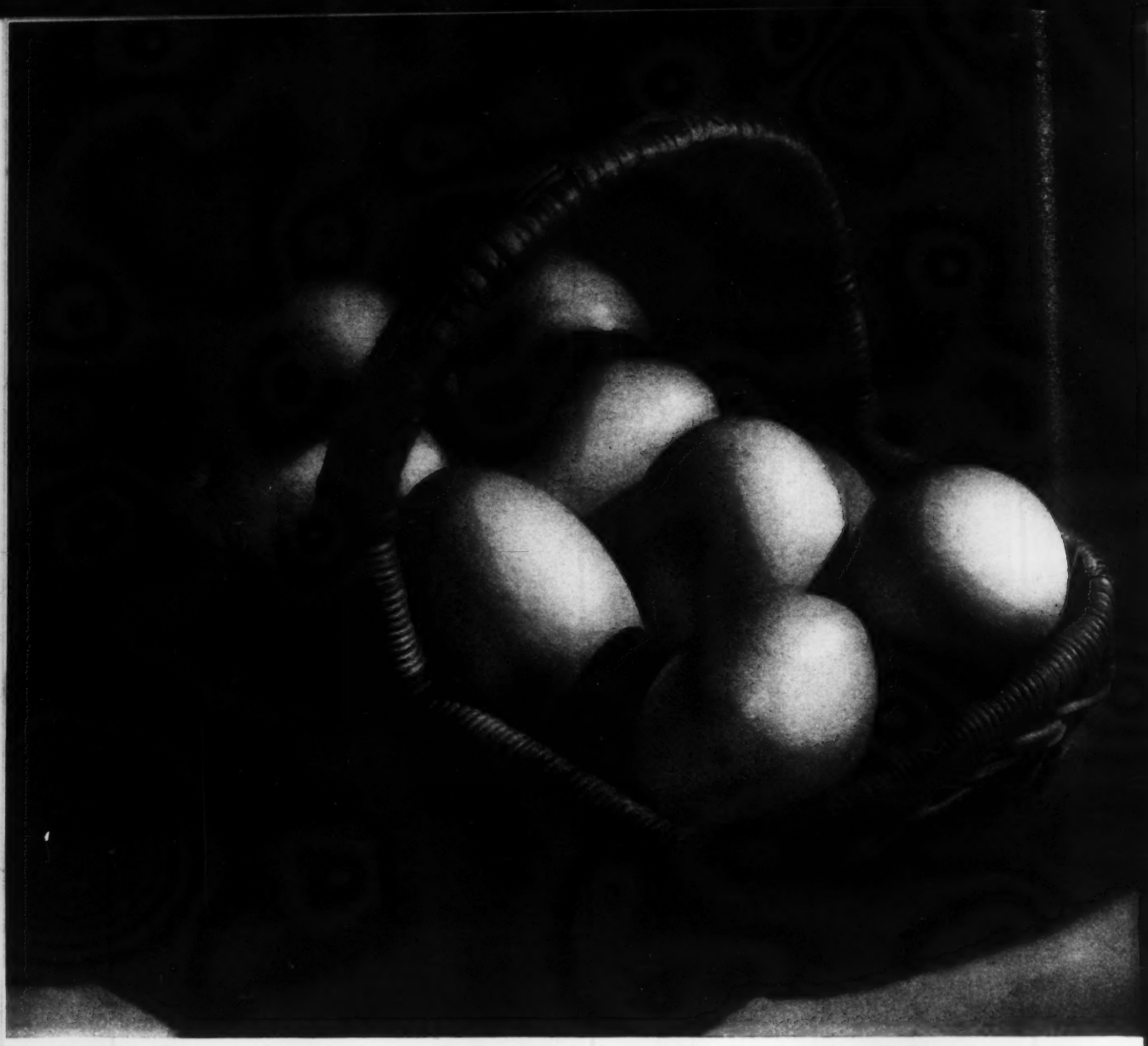
Bleaching powder, in drums, f.o.b. works, per 100-lb	$2.25–3.10
Chlorine cylinders, liquid, per lb. delivered	.0525
Calcium chloride, 77–80%, flaked, in 400-lb. drums or 100-lb. paper bags, delivered, per ton	18.50–35.00
Silicate of soda, 52 deg., in drums, f.o.b. works, per 100 lb	1.40
Soda ash, 58%, in paper bags, per 100 lb. dense	1.15
Sulphate of aluminum, commercial, in 100-lb. bags, per ton	23.00-25.00
Sulphate of copper, in bbl., per 100-lb	5.15–5.50

YES, IT'S ONE OF "OUR BOYS" writing—but he's not being prejudiced. Hyatt's *do* play a major part in Army and Navy equipment ... in tanks and guns and planes and ships ... in the machines that make the machines of war. Everywhere, every day, precision-made Hyatt Bearings are serving well in America's drive toward victory.



Our young soldier's buddies in Department 9 at Hyatt are justly proud of him—and he can be equally proud of them. For they are soldiers, too ... in the front lines of industry ... working with might and main, day and night ... keeping a steady flow of vital parts for the fighting machines that our fighting men are using with such telling effect! Hyatt Bearings Division, General Motors Corporation, Harrison, N. J., Chicago, Pittsburgh, Detroit and San Francisco.

THE 50TH YEAR OF HYATT ROLLER BEARINGS



A Picture of Sound Engineering

WE BELIEVE IT'S SOUND common sense to put all your eggs in one basket — if it's the *most dependable* basket.

By the same token, we believe it's sound engineering to rely on one line of valves — the *most dependable* line — throughout a plant.

For when you consider the multitude of valves in any plant and consider how replacements and maintenance are multiplied over the years, you realize the dollars-and-cents-importance of long lasting, trouble-free valves *throughout*.

We believe that Jenkins Valves last longer, keep tighter and require less maintenance than any other valves made. It is a belief based on the records of actual installations of Jenkins Valves and their almost incredible performance over long periods of time. In our files you will find records, by the hundreds, of Jenkins Valves that have given satisfactory service with little or no maintenance for up to 50 years or more.

With such a reputation — based on fact — doesn't it seem sound engineering to depend on Jenkins Valves? *Especially since you pay no premium for Jenkins Quality!*

AVAILABLE AT GOOD SUPPLY HOUSES EVERYWHERE. Jenkins Bros., 80 White Street, New York. Bridgeport, Atlanta, Boston, Philadelphia, Chicago, Houston. Jenkins Bros., Ltd., Montreal; London, Eng.

JENKINS VALVES

Cover every plumbing, heating and industrial service . . . Bronze, Iron, All-Iron, Cast Steel and Corrosion-Resisting Alloys . . . from ⅛ in. to 36 in. . . . from 125 lbs. to 600 lbs. pressure.

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME—DELIVERED

	STRUCTURAL CLAY TILE — PARTITION — SCORED Per M. lots of 2,000 pieces or over,			STRUCTURAL CLAY TILE — LOAD BEARING — SCORED Per M. lots of 2,000 pieces or over,			BRICK Per M. in quantity,		LIME		
	3x12x12 in.	4x12x12 in.	8x12x12 in.	8x12x12 in.	10x12x12 in.	12x12x12 in.	Common backing	Straight hard	Per ton, Hydrated finishing	In paper, Common hydrated	Carload lot, Pulverized or lump
Atlanta	$100.00	$110.00	$195.00	$230.00	$240.00	$240.00	$13.50	$18.00	$26.50	$15.00	$15.00
Baltimore	80.00	85.00	160.00	190.00	255.00	315.00	14.00k	17.00k	18.00	12.00	2.50m
Birmingham	80.00	85.00	160.00	191.00	252.00	288.00	14.50	17.00	18.11	13.64	2.25o
Boston	88.40u	94.30u	176.90u	200.40	260.90	325.00	18.00i	21.00i	21.00	15.00	16.00
Chicago	68.10	72.60	135.90	185.70	234.90	268.10	12.00	14.00	17.00	15.50	12.50
Cincinnati	65.55	69.90	131.20	148.70	210.35	240.45	17.50	17.50	15.40	12.90	.....
Cleveland	60.00	64.00	120.00	144.00	193.00	221.00	17.00	17.00	14.50j	13.25j	3.00jm
Dallas	52.00	54.00	100.00	135.00	200.00	263.00	11.50i	13.50i	19.00	15.00	.95n
Denver	84.80	94.40	152.70	178.20	212.00	227.90	13.50	17.00	30.00j	19.00j	30.00j
Detroit	78.20	86.40	159.60	203.00	263.50	301.00s	17.50	18.00	16.50	13.90	14.90
Kansas City	67.00	69.00	89.00c	128.00	163.00	189.00	16.00	24.00	19.32	13.00	10.92
Los Angeles	73.50tr	89.50tr	128.00ctr	210.00tr	368.00tr	460.00tr	13.50	15.00	16.50	17.50	17.50
Minneapolis	81.00b	86.40b	146.90b	.....	177.00b	246.00b	13.60	15.60g	21.00	16.00	19.00
Montreal	72.20au	77.50au	142.50au	76.00autu	165.80au	248.70u	22.00tu	27.10tu	23.50u	17.00u	12.00u
New Orleans	72.00	72.00	135.00	162.00	210.00	260.00	14.00	.....	18.30	12.08	14.10
New York	78.40	83.60	115.00c	193.30h	238.80h	295.60h	13.50	.....	20.00	14.00	17.00
Philadelphia	90.00	97.70	183.20	197.10	243.20	301.10	17.00s	20.00s	15.50q	8.55q	10.55q
Pittsburgh	62.35	66.55	124.75	140.25	173.25	198.00	17.50	19.50	17.90	15.40	2.55m
St. Louis	62.00	88.00	120.00	180.00	234.00	280.00	17.00	18.00	22.00	18.00	18.00
San Francisco	84.00	94.50	225.00	.....	.....	.....	17.50	22.00	20.00	20.00	16.40
Seattle	105.00	115.00	210.00	.....	.....	.....	18.00f	22.00f	20.00s	20.00s	20.00s

† F.o.b. a Smooth. b Carload lots delivered to job. c 6x12x12 in. d Not load bearing. e 48 lb. tile. f Less $1.00, ½ cash 15 days, balance 30 days. g Selected common. h F.o.b. Perth Amboy, N. J. i 50c. per M. off for cash. j LCL. k $1.00 discount if paid in 10 days. l Lump. m Per bbl., 180 lb. n Per sack 100 lb. o Per bbl., 200 lb. p 280 lb. bag. q 25-ton cars. r 5% discount 10 days. s 2% off cash. t 5½ x 8 x 12. u Plus 8% sales tax.

PAINT, ROOFING—F.O.B. CARLOAD LOTS

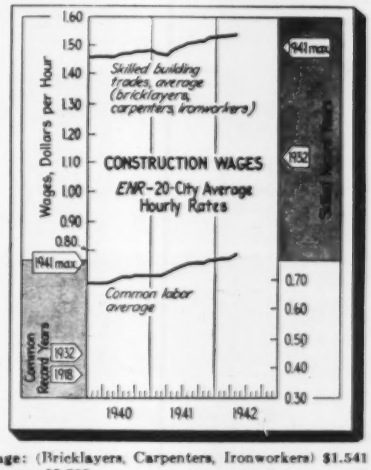
	RED LEAD Per 100 lb. in 600-lb. (Approx.) bbl. Dry a	WHITE LEAD Per 100 lb. in oil	READY-MIXED PAINT Per gal., drums Graphite b	Aluminum c	Ferric Oxide d	ROOFING SUPPLIES Carload lots f.o.b. factory Rolls, slate surfaced, 85-90 lb. per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating per gal.	Tar pitch 350 lb. bbl. per ton
Atlanta	$10.25	$14.125	$1.30	$2.25	$1.20	$1.90	$1.61	$1.61	$0.27	$29.00
Baltimore	10.00	13.75	1.95	2.90	2.50	2.10	2.50	2.50	.35	30.00
Birmingham	10.25	14.125	2.35	3.50r	1.85	2.04	1.97	1.97	.32	28.35
Boston	10.00	13.75	2.70‡	3.65‡	2.50‡	1.85‡	1.85h‡	1.85h‡	.50‡	20.00‡
Chicago	10.00	13.75	2.11	2.63	1.72	1.55h/	1.50h/	1 50h/	.26/	22.00/
Cincinnati	10.00	13.75	1.70	2.90	1.60	2.40	2.39h	2.39h	.36	21.00
Cleveland	10.00	13.75	2.90	4.80	2.30	1.93	1.83h	1.83h	.40	25.00
Dallas	10.00	14.50	1.88	2.11n	....	2.30h	2.25h	2.45h	.35	39.00
Denver	10.50	14.25	1.65	2.60	.27l	2.45	3.15	3.15	.35	28.00
Detroit	10.00	13.75	1.75	3.00	1.60	2.40	2.50	2.50	.35	21.00
Kansas City	10.00	13.875	2.39g	2.55gr	2.16gn	2.10	2.30	2.30	.28	27.50
Los Angeles	10.25	14.25	1.60	2.25	2.30	2.10	1.50	....	.45	.....
Minneapolis	10.00	13.875	....	....	....	1.75i	1.66hi	1.66hi	.32	23.00
Montreal	9.25	11.07	2.40p	2.97p	2.51p	2.85	2.58	2.01	.63	1.85h
New York	10.00	13.75	2.05	2.55	1.64	1.66	1.58h	1.58h	.26	25.00
Philadelphia	10.00	13.75	....	....	....	1.75	1.66	1.66	.32	23.00
Pittsburgh	10.00	13.75	1.05	1.95	.80	1.95	1.94h	1.94h	.34	26.00
St. Louis	10.00	13.75	1.90/2.00	2.60/2.80	1.60/2.00	1.75	1.66	1.66	.34	24.00
San Francisco	10.25	14.00	1.80	2.75n	1.10/2.00	1.89	2.66	2.66	.33	19.50
Seattle	10.25	14.25	1.90	3.00	....	2.15	2.16h	....	.35	26.50j

‡ Delivered. Note: Red lead in oil 50c. higher than white lead in oil. a Red lead prices change frequently due to pig lead price changes. b U. S. War Dept. Spec. 3-49A. c ASTM Spec. D266-31. d 80% minimum ferric oxide. e Subject to 25% discount. f Distributors' price to contractors. g 5 gal. can h Per roll, 65 lb. i Minneapolis and vicinity. j Asphalt pitch. k Per 100 lb. l Per lb. m Per bbl. n May price, no later quotation available. p Plus 8% sales tax r Not available.

SKILLED AND COMMON WAGE RATES—PER HOUR

	Bricklayers	Carpenters	Struct. Iron Workers	Hoisting Engineers	Plasterers	Common Labor Building	Common Labor Heavy Const.
Atlanta	$1.375	$1.00	$1.375	$1.00/1.25	$1.25	$0.40	$0.50
Baltimore	1.625	1.375	1.65	1.65	1.50	.70	.70
Birmingham	1.75	1.125	1.50	1.50	1.50	.65	.65
Boston	1.50	1.375	1.50	1.875	1.625	.85	.85
Chicago	1.70	1.625	1.70	1.70	1.825	1.025	1.025
Cincinnati	1.75	1.50	1.625	1.40/1.55	1.625	.80	.80
Cleveland	1.75	1.50	1.75	1.75	1.75	1.00	1.00
Dallas	1.50	1.00	1.25	1.00	1.50	.50/.625	.50/.625
Denver	1.65b	1.43b	1.43b	1.43b	1.51b	.718b	.718b
Detroit	1.60	1.40	1.75	1.625	1.675	.80	.80
Kansas City	1.625	1.375	1.50	1.50	1.575	.85	.50
Los Angeles	1.50	1.175	1.50	1.50	1.667	.75	.75
Minneapolis	1.50	1.25	1.50	1.40	1.50e	.90	.90
New Orleans	1.50	1.25	1.50	1.375	1.375	.60	.60
New York	2.00b	1.85b	2.00	2.00b	2.00c	1.031	.95
Philadelphia	1.825	1.50	1.80	1.65	1.8775	.775	.775
Pittsburgh	1.90	1.50	1.75	1.5625/1.625	1.75	.80	.70
St. Louis	1.25/1.50	1.50	1.75	1.50/2.00	1.25/1.75	.675/.875	.875
San Francisco	1.75c	1.375	1.60	1.50	1.667c	.875	.875
Seattle	1.715	1.415	1.615	1.565	1.715	1.015	1.10
Montreal	.92	.81	.87	.76	.90	.53	.46

b 7 hr. day. c 6 hr. day. d 35 hr. wk. e 30 hr. wk.



ENR Skilled Average: (Bricklayers, Carpenters, Ironworkers) **$1.541**
ENR Common Average: $0.788

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The scene might be in the Western Plains Country, or it might be somewhere near sea water, but regardless of location, it is a story that can't be told now. Never have such water systems been constructed. The idea is entirely new and is of major importance to the armed forces.

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Layne-Northern Company	Mishawaka, Ind.
Layne-Louisiana Company	Lake Charles, La.
Layne-New York Co.	New York City.
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Layne-Texas Company	Houston, Texas.
Layne-Western Company	Kansas City, Mo.
Layne-Western Co. of Minn.	Minneapolis, Minn.
Layne-Bowler New England Corp.	Boston, Mass.
International Water Supply, Ltd.	London, Ont.

WORLD'S LARGEST WATER DEVELOPERS

Reports and Pamphlets

(*Continued from p. 96*)

U. S. GOVERNMENT MANUAL—1942. Superintendent of Documents, Washington, D. C. Price 75c.

FEDERAL WORKS AGENCY—Second annual report 1941. Superintendent of Documents, Washington, D. C. 65c.

STUDY OF THE PARK AND RECREATION PROBLEM OF THE UNITED STATES—National Park Service, Superintendent of Documents, Washington, D. C. Price $1.25.

INTERSTATE SANITATION COMMISSION (New York, New Jersey and Connecticut), Annual Report, 1941. 60 Hudson St., New York.

TUBERIAS ECONOMICAS EN LOS SISTEMAS DE DISTRIBUCION DE AGUA POR GRAVEDAD—Por los Ingenieros, Jose Gama y Nicholas Duran. Imp. Aldina, Robredo Y. Rosell, S. R. L. Art. 123, 86, Mexico, D. F.

POSSIBLE ALTERNATES FOR NICKEL, CHROMIUM AND CHROMIUM-NICKEL CONSTRUCTIONAL ALLOY STEELS—American Iron and Steel Institute, 350 Fifth Ave., New York. Price 50c.

SURFACE AND UNDERGROUND WATERS OF OHIO—Engineering Experiment Station, Circular No. 43. Ohio State University Studies, Engineering Studies.

A CLOSER LOOK at the Potential Traffic Claimed for the St. Lawrence Route—Association of American Railroads, Washington, D. C.

OUTLINE OF STATE AGENCIES ADMINISTERING LABOR LAWS—Bulletin No. 49. U. S. Department of Labor. Division of Labor Standards. Price 40c.

1941 PROCEEDINGS—Institute of Traffic engineers. Office of the Secretary, 60 John Street, New York.

TRAINING OXY-ACETYLENE WELDING AND CUTTING OPERATORS—Instructor's Outlines Including Outline Course for Inspectors. International Acetylene Association, 30 East 42nd Street, New York. Price 25c.

HOUSING FOR TOMORROW—Annual report of the Memphis Housing Authority 1941. Administration Building, 264 North Lauderdale Street, Memphis, Tenn.

NIGHT SAFETY BOUGHT CHEAPLY—A reprint from *Illumination Engineering*. Distributed by The Street and Highway Lighting Safety Bureau, 155 East 44th Street, New York.

SHIPBUILDING TERMS—American Technical Society, 58th at Drexel Avenue, Chicago, Illinois. Price 50c.

(*Continued on p. 107*)

DAM IN PENN'A

The photo shows the sealing with "GUNITE" of the rocky sides of a gorge, preparatory to building an earth dam. Any type of dam or reservoir construction is most economical and of greatly superior value, when reinforced "GUNITE" is employed. Write us for expert advice and estimate of cost.

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Look For This Mark of STERLING Quality
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(*Continued from p. 106*)

NATIONAL COUNCIL OF STATE BOARDS OF ENGINEERING EXAMINERS—Year Book. Proceedings twenty-second annual meeting. P. O. Drawer 1404, Columbia, S. C. Price $2.

PROCEEDINGS of the First Annual Conference on Surveying and Mapping. Texas Engineering Experiment Station, College Station, Texas.

SUFFOLK COUNTY MOSQUITO EXTERMINATION COMMISSION—Annual Report, 1941, Yaphank, N. Y.

VIVIENDAS POPULARES—No. 9 Serie B. El Cemento Portland En La Construccion De Edificios. Distributed free on request by the "Instituto del Cemento Portland Argentino" Calle San Martin 113F—Buenos Aires, Argentina.

CRITERIOS DE RESISTENCIA—Pelo Eng. Telemaco Van Langendonck. Separata Do Boletim Do Instituto De Engenharia. Sao Paulo, Brasil.

OLYMPIA, WASHINGTON—Statistics of Water Companies 1940. State of Washington, Section of Valuation and Research, Olympia, Washington.

SPACE FOR TEACHING—An Approach to the Design of Elementary Schools for Texas. By William Wayne Caudill. Engineering Experiment Station, series No. 59. College Station, Texas.

PUBLIC EMPLOYMENT AND THE WAR—A Functional Analysis with Special Attention to State and Local Government. U. S. Department of Commerce, Bureau of the Census, Washington, D. C.

BARRETT TARVIA MANUAL—The Barrett Division, Allied Chemical and Dye Corporation, U. S. A. and Canada.

CURRENT HYDRAULIC LABORATORY RESEARCH IN THE UNITED STATES—Bulletin X, January, 1942. National Bureau of Standards, Washington, D. C.

1941 LAWS BULLETIN NO. 5—A digest of New Legislation Affecting Highway Users. National Highway Users Conference, Washington, D. C.

PROGRESS REPORT 1940–1941—National Resources Planning Board, Washington, D. C.

MODERN DEVELOPMENTS IN REINFORCED CONCRETE—Structural Bureau, Portland Cement Association, 33 West Grand Ave., Chicago, Ill.

HISTORY OF MISSOURI HIGHWAY DEPARTMENT. Highway Planning Survey Division, Jefferson City, Mo.

PROCEEDINGS OF THE 13TH SEMI-ANNUAL EASTERN PHOTOELASTICITY CONFERENCE—Copies obtainable from W. M. Murray, Massachusetts Institute of Technology, Cambridge, Mass. $2.

INJEKTIONEN—Verfestigung und abdichtung von durchlassigen Boden, fein zerr-

(*Continued on p. 108*)

These machines are representative examples of the wide variety of applications of Briggs & Stratton motors.
POWER TANK HEATER
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USERS . . . of Gasoline-Powered Equipment know the Power is right when powered by "Briggs & Stratton."
Known to millions — the Briggs & Stratton trademark on the motor of gasoline-powered equipment is a distinctive emblem of dependable, economical, easy starting power . . . Trouble-free performance on a vast variety of machines, tools, and appliances — in governmental service, on farms, and in industry — has earned an extraordinary recognition for Briggs & Stratton air-cooled gasoline motors.
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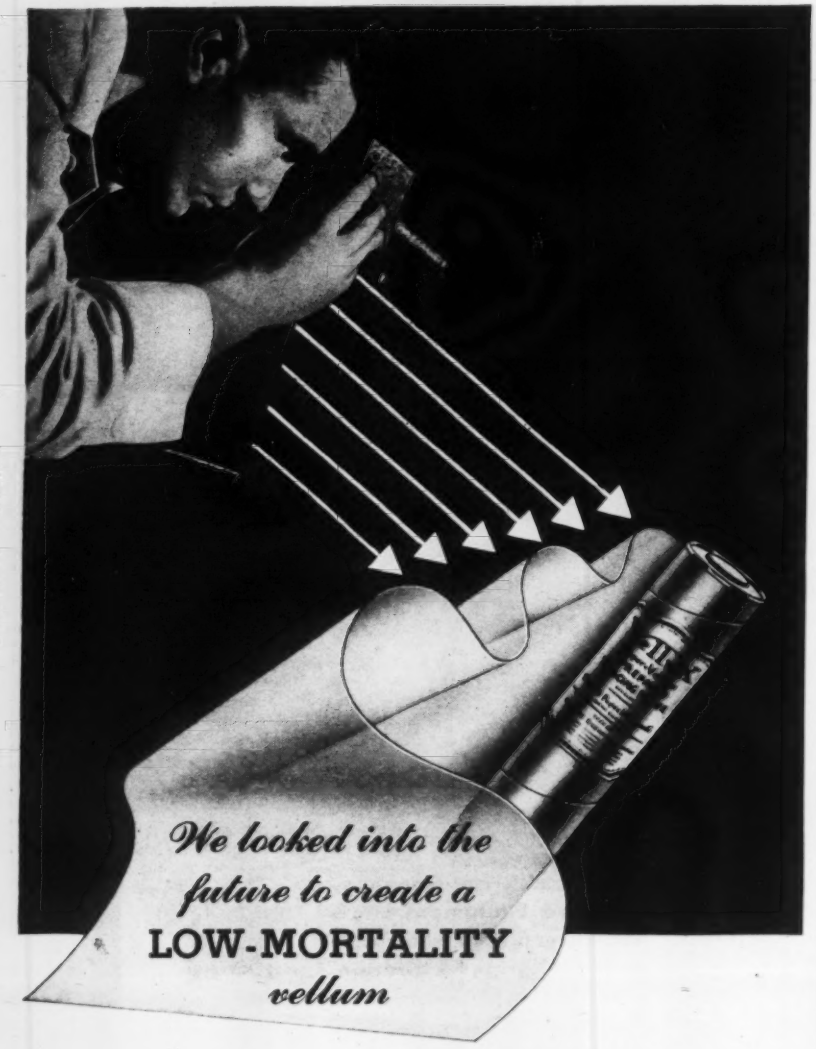
GASOLINE MOTORS



MOST vellum tracing papers look good at a glance. But the real test of vellum value is in what happens weeks—months or years later. Does the vellum have high or low "mortality"? Will it turn yellow? Will it become brittle? Will it go to pieces in handling or in the file?

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SPEEDS—SIMPLIFIES—AND PROTECTS A NATION'S DRAFTING

(*Continued from p. 107*)

lufteten Gesteinen, porosem Mauerwerk, Beton etc. Leeman & Co., Zurich, Switzerland.

A. S. T. M. STANDARDS ON MINERAL AGGREGATES — Specifications, Definitions, Methods of Testing. American Society for Testing Materials. 260 S. Broad St., Philadelphia, Pa. $1.25.

PROVA DE CARGA DA PONTE DE ITU, SOBRE O RIO TIFTE—Separata do Boletim do Departamento de Estradas de Rodagem. Sao Paulo, Brazil.

THE QUEBEC STREAMS COMMISSION—25th Annual Report, for the year 1936. Quebec, P. Q., Canada.

MONTREAL, P. Q.—Report of the Department of Health, 1940.

METROPOLITAN DISTRICT WATER SUPPLY COMMISSION, Commonwealth of Massachusetts.—Annual report, 1939.

FLEXURAL-TORSIONAL BUCKLING OF BARS OF OPEN SECTION—By J. N. Goodier. Bulletin No. 28. Cornell University Engineering Experiment Station, Ithaca, N. Y.

THE BUCKLING OF COMPRESSED BARS BY TORSION AND FLEXTURE—By J. N. Goodier. Bulletin No. 27. Cornell University Engineering Experiment Station, Ithaca, N. Y.

LOS MUROS DE EMBALSE MAS IMPORTANTES DE LOS ESTADOS UNIDOS DE AMERICA (The most important dams of the United States of America)—By Nestor Jose Ottonello. Copies may be obtained at Tomas Palumbo, Lamadrid 321, Buenos Aires. $2.50 Argentine money.

HORMIGONES LIVIANOS (Light-weight concretes)—By Nestor Jose Ottonello. Copies may be obtained at Tomas Palumbo, Lamadrid 321, Buenos Aires. $5 Argentine money.

STRUCTURAL DESIGN OF FLEXIBLE PIPE CULVERTS—By M. G. Spangler. Bulletin No. 153. Iowa Engineering Experiment Station, Ames, Iowa.

ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT—Ninth annual report of conference of engineering bodies.

SUITABILITY OF STABILIZED SOIL FOR BUILDING CONSTRUCTION—By Edwin L. Hansen. Engineering Experiment Station Bulletin Series No. 333. University of Illinois, Urbana. 45c.

INHERENT ADVANTAGES OF MOTOR TRANSPORTATION—By Harry E. Stocker. National Highway Users Conference. National Press Building, Washington, D. C.

ST. LOUIS, MO.—Twenty-eighth annual report of the City Plan Commission.

NATIONAL RESOURCES DEVELOPMENT—Annual report 1941. Superintendent of Documents, Washington, D. C. 55c.

MEN AND JOBS

J. N. Pease, who as a civilian engineer had charge of the architecture and engineering on the expansion of Fort Bragg, N. C., a year ago, now is a colonel in the Corps of Engineers at that post.

Donald Driscoll, materials analyst with the South Dakota State Highway Testing Laboratory, resigned recently to accept a post with the Corps of Engineers.

O. D. Miller and **James Howe** are among the engineers making surveys of the Yadkin River valley in North Carolina for the Charleston, S. C., office of the Corps of Engineers, in the interests of a proposed flood control program.

Samuel G. Mastrianni, Lackawanna County, Pa., engineer, has been granted a leave of absence to enter U. S. naval service.

J. J. Flickinger, former engineer for the Ohio State Highway Department, has been named city engineer of Niles, Ohio, on a provisional appointment to succeed R. J. MacLean, who resigned recently.

Norbert Gardner, former WPA project superintendent in Milwaukee, has been appointed director of public works at Greendale, Wis., a government housing village.

Chester F. Lewis, city manager of Morgantown, N. C., has been granted an indefinite leave of absence to permit him to join the Wilmington, N. C., district office of the Corps of Engineers.

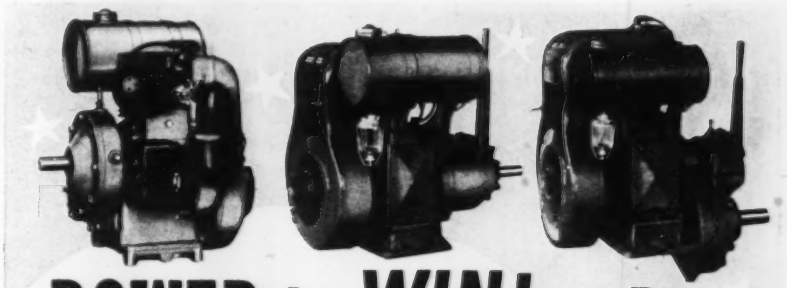
F. W. Pittman, bituminous inspector for the North Carolina State Highway and Public Works Commission, of Raleigh, N. C., has resigned to enter army service.

Aime Lefort has been named superintendent of public works of Verdun City, Que.

E. H. Williams, formerly a construction engineer with the contractor building an Iowa ordnance plant, has become an instructor in the civil engineering department at Wayne University, Detroit, Mich.

Joe Devine, a civil engineering graduate of Iowa State College, has become an aviation cadet at Higley Field, Chandler, Ariz.

R. J. Templeton, Talcott Moore and **Ned Williams,** all engineers for the Wyoming State Highway Department, recently resigned their posts to go on active duty with the Corps of Engineers. Mr. Templeton and Mr. Moore, both



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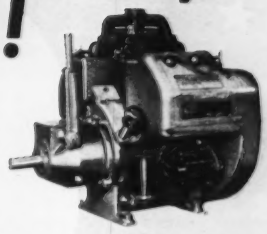
● In terms of man-hours saved, and productive capacity of machines increased . . . Wisconsin heavy-duty air-cooled engines are supplying the United Nations and Industry-at-Large with the Power to Win! Ready to *start* and go anywhere, in any weather, these air-cooled engines have the inbuilt stamina and dependability that count for so much at a time when neither time, power nor effort can be wasted.



A complete range of sizes, from 1 to 35 hp., 1 and 4-cylinder models. Specified as standard power equipment by more than 300 manufacturers.

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World's Largest Builders of Heavy-Duty Air-Cooled Engines

GAIN 65 TO 430% MORE LINER STRENGTH!

ARMCO Plates provide more strength with less weight. Design makes the difference.

GAGE	SECTION MODULUS		
	PER IN.	PER FOOT	PER SECT.
12	.1146	1.375	2.063
10	.1459	1.751	2.627
8	.1766	2.119	3.179
7	.1933	2.320	3.479

• Gage for gage you'll find ARMCO Heavy Duty Tunnel Liner 65% to 430% stronger (section modulus) than any other plate. Here's what this greater strength with less weight means in terms of easier, safer tunneling . . . .

On a strength/weight basis ARMCO Plates cost less at the start. You save on installation because the work moves fast. One man handles the light sections and only structural wrenches are needed for assembly. Where completed rings can be spaced to take advantage of partly self-supporting ground, you may actually buy fewer plates.

Let ARMCO Liner Plates help speed the work and cut costs. There is a wide range of sizes and gages for light or heavy duty service. Write for the whole story. ARMCO DRAINAGE PRODUCTS ASSN., 85 Curtis Street, Middletown, Ohio.

ARMCO

TUNNEL LINER PLATES

veterans of 20 years of service with the department, will become majors, while Williams, a member since 1928, will become a captain.

Maj. Howard O. Graham has been named area engineer in charge of construction at the Savannah Ordnance Depot and the Rock Islanda, Ill., arsenal.

John T. Tucker, secretary-chief engineer of the North Dakota State Water Conservation Commission, will be one of North Dakota's two representatives on the Missouri River States Committee.

Frank M. Rinehart, of Greenville, Miss., formerly in charge of construction at an army base there, has been called to active duty as a second lieutenant with the Corps of Engineers.

M. E. McCoy, Topeka, Kan., civil engineer and veteran of the Philippine Insurrection and the World War, recently reenlisted in the Corps of Engineers.

William D. Williams, consulting engineer of Stillwater, Minn., has assumed duties as engineer in charge of sanitation and water supply at a defense plant at Wahoo, Neb.

Winston B. Taylor, Oxford, N. C., has been named sanitary engineer for the Person area of the Person, Orange and Chatham Tri-County Health Department, making his headquarters at Roxboro, N. C.

John E. Wiley, for the past several years secretary-engineer of the Wyoming Contractors Association, has been commissioned a captain in the Engineer Corps of the U. S. Army.

E. H. Thomas, formerly resident maintenance engineer with the U. S. Bureau of Public Roads, is now field engineer with the Pacific Naval Air Base Contractors at Pearl Harbor, Honolulu, T. H.

Lt. Col. Rufus W. Putnam, former district engineer at Chicago, and **V. R. Stirling,** recently head of navigation studies of the St. Lawrence seaway, have joined the staff of **Col. Roger G. Powell,** Great Lakes division engineer, Corps of Engineers.

D. B. Margules, who has been special assistant to the resident general manager for a subcontracting firm on an ordnance works construction job at Marche, Ark., has been named resident manager.

Col. T. F. Kern, district engineer at Little Rock, Ark., Corps of Engineers, since 1940, has received orders to report for duty with troops. He will be succeeded by **Lt. Col. A. M. Neilson.**

Now!

BETTER, SMOOTHER HARDER, STRONGER CONCRETE SURFACES

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ABSORPTIVE FORM LINER

CELOTEX Absorptive Form Liner removes excess water and trapped air from concrete, producing a smooth, dense, hard outer layer. Better appearance, greater durability, greater abrasion resistance are some of the results! Successfully used on dams, aqueducts, bridge piers, docks, stadia, etc.

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G&R Pumps differ from other self-priming centrifugals because they have no re-circulation orifice to clog, nor a shut-off valve to jam. The water passage has the same area as the suction hose and nowhere is the water velocity checked, thus allowing no solids to accumulate and clog the pump. (Note water passage in sectional drawing.) With G&R Pumps there are no shut downs for cleaning out . . . Insist on the Gorman-Rupp—the only truly non-clogging contractor's pump.

Stocked for immediate shipment in 100 prinicpal cities

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MEETINGS

AMERICAN INDUSTRIAL HYGIENE ASSOCIATION, annual meeting, Hotel Gibson, Cincinnati, Ohio, April 13–17.

NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS, annual meeting, Ambassador Hotel, Atlantic City, N. J., April 16–18.

AMERICAN CONGRESS ON SURVEYING AND MAPPING, second annual meeting, National Museum, Washington, D. C., April 16–17.

AMERICAN WATER WORKS ASSOCIATION, Stevens Hotel, Chicago, June 21–25.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, 50th annual meeting, Columbia University, New York City, June 29–July 2.

AMERICAN SOCIETY OF CIVIL ENGINEERS, Spring meeting, Hotel Roanoke, Roanoke, Va., April 22–23.

AMERICAN SOCIETY OF PLANNING OFFICIALS, Indianapolis, Ind., May 24–28.

REGIONAL AND LOCAL MEETINGS

NEW ENGLND WATERWORKS ASSOCIATION, Hotel Biltmore, Providence, R. I., April 23 (in conjunction with the New England Health Institute).

MONTANA SECTION, AMERICAN WATER WORKS ASSOCIATION, Helena, Mont., April 16–17.

WESTERN ASSOCIATION OF STATE HIGHWAY OFFICIALS, annual meeting, Salt Lake City, Utah, April 17–18.

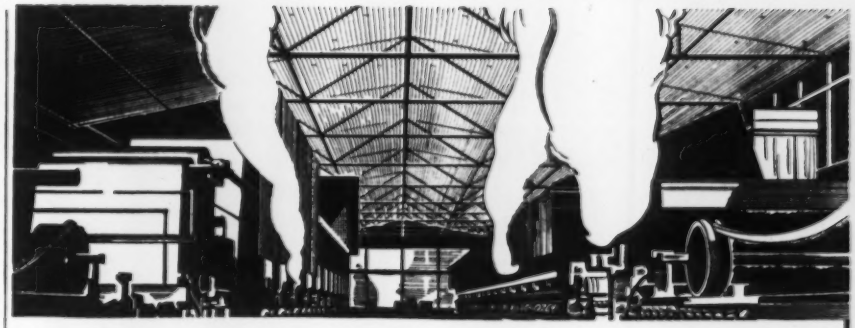
NEW ENGLAND WATER WORKS ASSOCIATION, Manchester Country Club, Manchester, N. H., May, 1942. (Date to be announced.)

NEW YORK STATE SOCIETY OF PROFESSIONAL ENGINEERS, annual convention, Hotel New Yorker, New York, N. Y., May 14–16.

NEW YORK SECTION, AMERICAN WATER WORKS ASSOCIATION, spring meeting, Hotel Niagara, Niagara Falls, N. Y., April 30–May 1.

Elections and Activities

JOHN L. SAVAGE, chief designing engineer of the Bureau of Reclamation, Denver, was honored by the Rocky Mountain section of the American Society of Civil Engineers at a recent dinner meeting with the presentation of a life membership in the American Society of Civil Engineers. Mr. Savage recently



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THEN THEY STARTED to use Wolmanized Lumber for roof planks and timbers, window frames and sash, and elsewhere in the mills. Because this wood is highly resistant to decay and termite attack, the need for replacements practically disappeared.

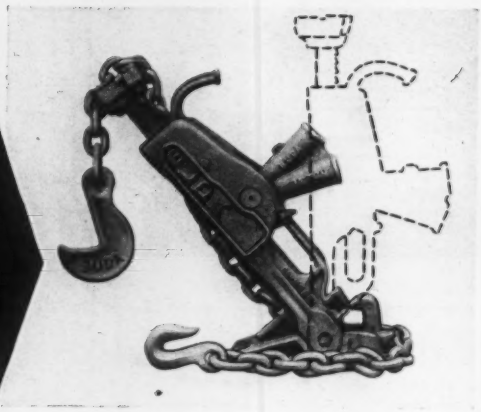
LOWER MAINTENANCE costs result when Wolmanized Lumber is used; service records covering millions of feet, some in use over fifteen years, are evidence of this fact. In addition, all of the advantages of wood construction are retained: ease and speed of erection, light weight, resilience, strength, high insulating value, and low first cost.

WOLMANIZED LUMBER is ordinary wood, made long-lived by vacuum-pressure impregnation with Wolman Salts* preservative. It is clean, odorless, and paintable. May we send you additional data? Write American Lumber & Treating Company, 1649 McCormick Bldg., Chicago, Ill.

*Registered Trade Mark

WOLMANIZED LUMBER

"Mechanical Muscles" — BUILT TO HANDLE 1001 LIFTING JOBS!



THE BUDA CO.
ESTABLISHED 1881
Harvey (Chicago Suburb) Ill.

• Shown here is the new Buda Automatic Lowering Jack Model 2215-S, versatile all-purpose 15 ton Jack for handling loads from vertical or angular positions. This is just one of the 170 Buda Jack models that serve as "mechanical muscles" to perform a thousand and one lifting jobs—raising, lowering, pushing, pulling—all with safety, speed, and with a minimum of attention. *Write for complete data and free literature.*

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Air in a Hurry— with LE ROI "GV" Portable Compressor

Quickly transported to the job site. Then just touch a button to get air. Built by the *only* manufacturer who makes *both* the engine and compressor. Put it to work for you — to get jobs done easier . . . quicker . . . at lower cost.

Le Roi-engineered to the special requirements of air compressor service . . .

Heavy-duty valve-in-head engine easily accessible — insures minimum lost time, repair costs.

Retractable caster wheel support makes moving on job easy.

Truck-type springs, cushioned towing eye — protect against road shocks.

Many other desirable features.

★ Both sizes, 85 and 105 cu. ft., described in bulletin 22G1. Write for it!

Other models 60 to 420 c.f.m.

C-9

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returned from Australia, where he had acted as consultant to the Australian government on hydro-electric plants and construction of dams.

PENNSYLVANIA highway department engineers and maintenance superintendents, at a spring meeting in Harrisburg recently, were warned by I. L. Hughes, secretary, that they face "a hard year." Hughes stressed the necessity for looking after the proper maintenance of the state's 40,500-mile road system in war time in order that defense materials can be kept rolling. He told engineers and superintendents that they will have to carry on with reduced personnel because of the demands for men in the armed forces and industrial establishments.

JOSEPH LUSTIG, of Janesville, Wis., was elected president of the Engineering Society of Wisconsin at a recent meeting. Other officers elected included Montrose K. Drewry, Milwaukee, vice president; J. A. Stemper, Janesville, and L. M. Schindler, Appleton, trustees; C. A. Wiepking, Milwaukee, was made secretary.

A CAMPAIGN to collect scrap steel to aid the nation's war work has been sponsored by the Wisconsin Road Builders' Association, according to an announcement by E. E. Hoebel, executive secretary. In offering the services of the association, the Wisconsin contractors expressed the belief that many carloads of scrap steel could be assembled after being obtained from abandoned bridges, viaducts, water towers, and other steel structures.

MAURICE C. MILLER, of Des Moines, was recently elected president of the Iowa Engineers Society. Other officers are: E. W. Blom, of Ames, vice president; A. F. Faul, of Des Moines, treasurer; L. L. Flint, of Des Moines, secretary; W. L. Anderson, of Primghar, chairman of the highway section; John Hiland, of Ames, chairman of the structural and architectural section, and A. E. J. Johnson, of Red Oak, chairman of the municipal section.

V. R. O'BRIEN, branch manager of the American Radiator & Standard Sanitary Corp., has been named president of the St. Paul Builders' Exchange, succeeding Harry D. Lovering, who recently entered military service. Mr. O'Brien had been vice president.

FRED J. HERRING, statistical engineer for the Arkansas State Highway Department, is the new president of the Little Rock, Ark., Engineers Club. Other officers elected at a recent meeting included Ray Metzger, vice president; Harold J.

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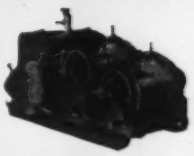

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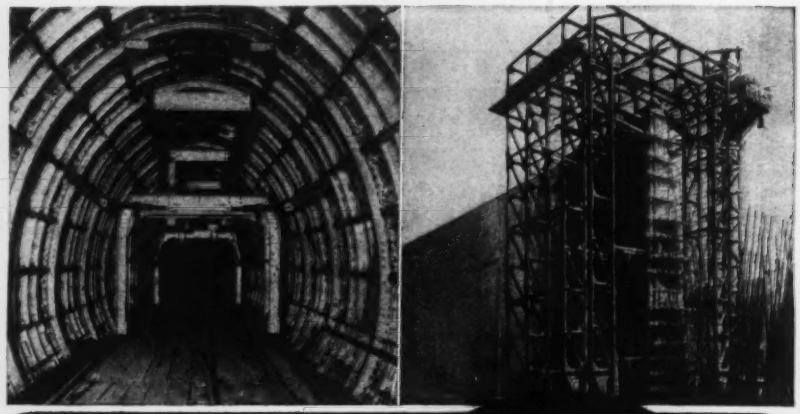

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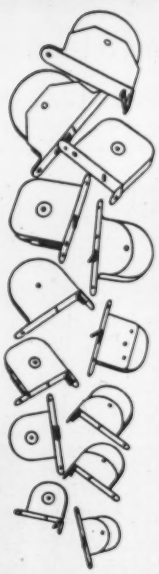

PULLMAN

Engstrom, Jr., secretary-treasurer, and Sam G. Devies, director.

JACQUES E. HURTUBISE, in charge of the laboratory for testing materials at the Ecole Polytechnique, of Montreal, is the newly elected chairman of the Junior Section of the Montreal Branch of the Engineering Institute of Canada.

GEORGE E. WILKINSON was elected president of the Charlotte, N. C., Engineers Club at a recent meeting of the organization. Wilkinson, who has been vice-president of the group, succeeds LARRY HILL, who recently resigned.

The NATIONAL UNION OF ENGINEERS, ARCHITECTS, CHEMISTS AND SIMILAR TECHNICIANS of the Mexican Republic at a recent meeting elected Ing. Juan Bringas de la Torre as secretary general; Ing. Ciro Orihuela Amado, interior secretary; Ing. Andres Ortiz, exterior secretary; Ing. Jose Rocha, treasurer; Ing. Wenceslao Ruiz, executive secretary; Ing. Salvador Teuffer, labor and conflicts secretary; Ing. Luis G. Jimenez, organization and publication secretary; Ing. Pascual Ortiz Rubio, former president of Mexico, chairman of the justice committee.

THE NORTHWEST GOOD ROADS ASSOCIATION will hold its annual meeting April 10 at the Nicollet Hotel, in Minneapolis, Minn. M. J. Hoffman, state highway commissioner for Minnesota, has been invited to speak.

JAMES U. MOOREHEAD, vice president of the Engineering Professions Club of Jacksonville, Fla., was elected president of the organization at a semi-annual banquet held at Jacksonville March 27. Other officers elected were: David B. Lee, vice president; E. J. Sperling, secretary; J. Gordon Jones, treasurer; and Leon M. Frank, program chairman.

CHESTER N. GINDER, of the Metropolitan District Water Supply Commission staff, was elected treasurer of the Boston Society of Civil Engineers, at a recent meeting. New directors are: Stanley M. Dore, also of the Metropolitan District Water Supply Commission, and Herman G. Dresser, engineer of Boston. Inducted as honorary members at the meeting were Charles M. Allen, professor of hydraulic engineering at Worcester Polytechnic Institute; Arthur W. Dean, former chief engineer of the Massachusetts Highway Commission, and Charles R. Gow, president of Warren Bros. Corp., Cambridge, Mass. Howard M. Turner and Allen J. Burdoin were recipients of the Desmond Fitzgerald medal of the society for their paper, "The Flood Hydrograph," presented at a recent meeting of the hydraulic section.

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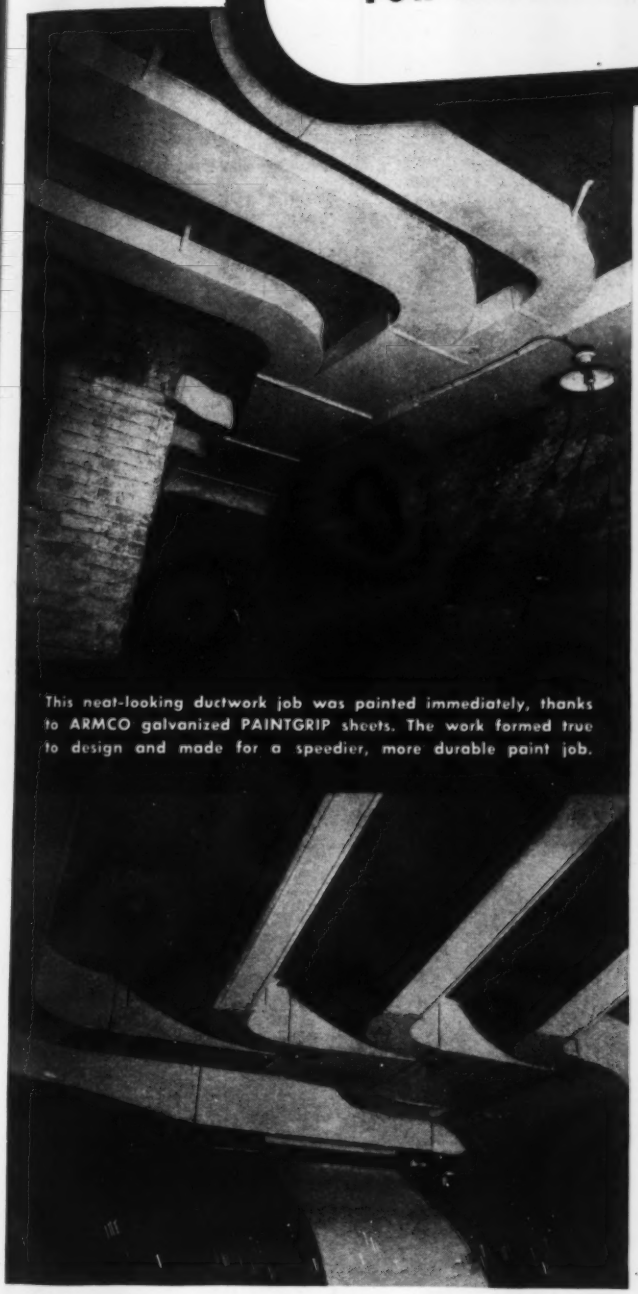

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ARMCO galvanized PAINTGRIP sheets are generally available for *immediate* delivery on high-priority orders. Telephone the nearest ARMCO Distributor or District Office, or write to us direct for more complete information. And when you do be sure to ask us for a *free* ARMCO galvanized PAINTGRIP scratch sample. The American Rolling Mill Company, 1381 Curtis Street, Middletown, Ohio.

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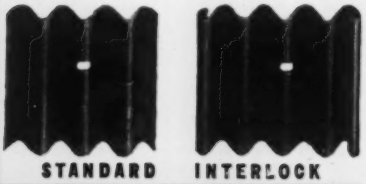

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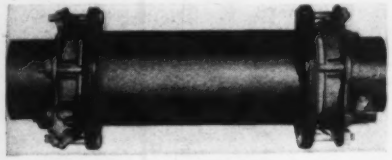
New Aids to the Constructor

Equipment and material announcements and manufacturers' news



Bomb Crater Clamp

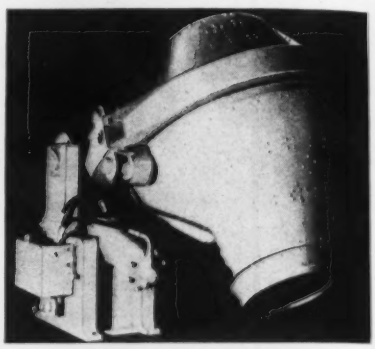
Gas and water companies in danger areas will be interested in a new device for quickly repairing mains where a gap has been blown out by the explosion. The new clamp, known as the Skinner-Seal Bomb Crater Clamp, makes a tight, lasting connection between the ends of the broken main and a random piece of steel pipe cut to appropriate length, to fill the space.—*M. B. Skinner Co., South Bend, Ind.*

Coal Tar Pitch for Incendiaries

A new processed coal-tar pitch that quenches the fires of incendiary bombs better than either sand or prepared compounds because it "seals in the flame" has recently been suggested for fire fighting use by the Bureau of Mines. Special sizes of the material are required for satisfactory use and this is available either in flakes or granulated form sold principally under the trade name "Chokeout." It is only necessary to completely cover the bomb and deprive it of air until the magnesium fire goes out. The bomb may then be shoved up and much of the magnesium recovered. "Chokeout" is available for use in industrial plants at $21 for a 300-lb. barrel.—*The Hommel Co., 211 Fourth Ave., Pittsburgh, Pa.*

Calculator

The Alco Products Div., of the American Locomotive Co. has made available a limited number of mean temperature difference calculators, devised to aid in the approximation of heat transfer surfaces when preparing estimates or specifications for heat exchanger equipment. The Calculator includes scales for the calculation of the logarithmic M.T.D., as well as the M.T.D. correction factors for one, two, three, four and six shell passes, and also "C" and "D" scales which permit multiplication and division operations.—*American Locomotive Co., 30 Church St., New York.*



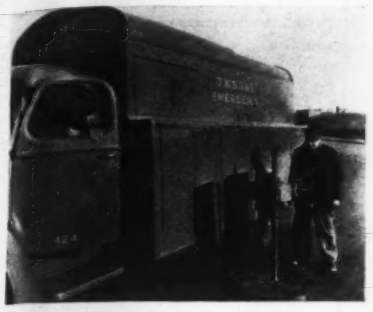
New 4-Yard Tilter

The T. L. Smith Co. has developed five new 4-yard tilters, of front end charging type, fed by one set of batchers and discharging concrete into a central hopper for use on TVA's new Fontana Dam, at Little Tennessee River, N. C. Features will include: All-welded box

Screw Spreader Used On Concreting Jobs

Shown above is a Jaeger screw spreader used in airport paving and on military roads, equipped with independently controlled right- and lefthand screw sections, eliminating the need for frequent reversals when building. In addition to their ability to spread and strike off skid mixes of as low as ½-in. lump concrete faster than many other types of pavers, these spreaders are said to emphasize the remixing and densifying effect of screw spreading in the absence of segregation, stone pockets and honeycomb.—*The Jaeger Machine Co., Columbus, O.*

girder pedestals and tilting frame, heat-treated, high carbon steel roller truck, drum gear and pinion with machine cut teeth and other features.—*The T. L. Smith Co., Milwaukee, Wis.*



Valve Operator

The Dean valve operator, shown in use on a truck, is a complete mechanism for transmitting as much power as is needed from the truck engine to the vertical valve key shaft and providing complete control of both speed and power. A heavy duty ball bearing power take-off is provided for attachment to the truck transmission, having one speed to close and one to open. Either push and pull or lever gear shifting attachment is mounted in the cab, within reach of the operator.—*Payne Dean, Peeskill, N. Y.*

Improved Mixer

Many improvements in the popular Wonder Plaster and Mortar Mixer have just been announced by Construction Machinery Co. The new mixer's lower charging height makes for easier and quicker charging, spring mounted bearing wheels are for faster trailing.—*Construction Machinery Co., Waterloo, Iowa.*

Prefabricated All-Steel Construction

To meet further increasing demands for the erection of small vital fireproof buildings for storage purposes and office facilities, contractors and companies are

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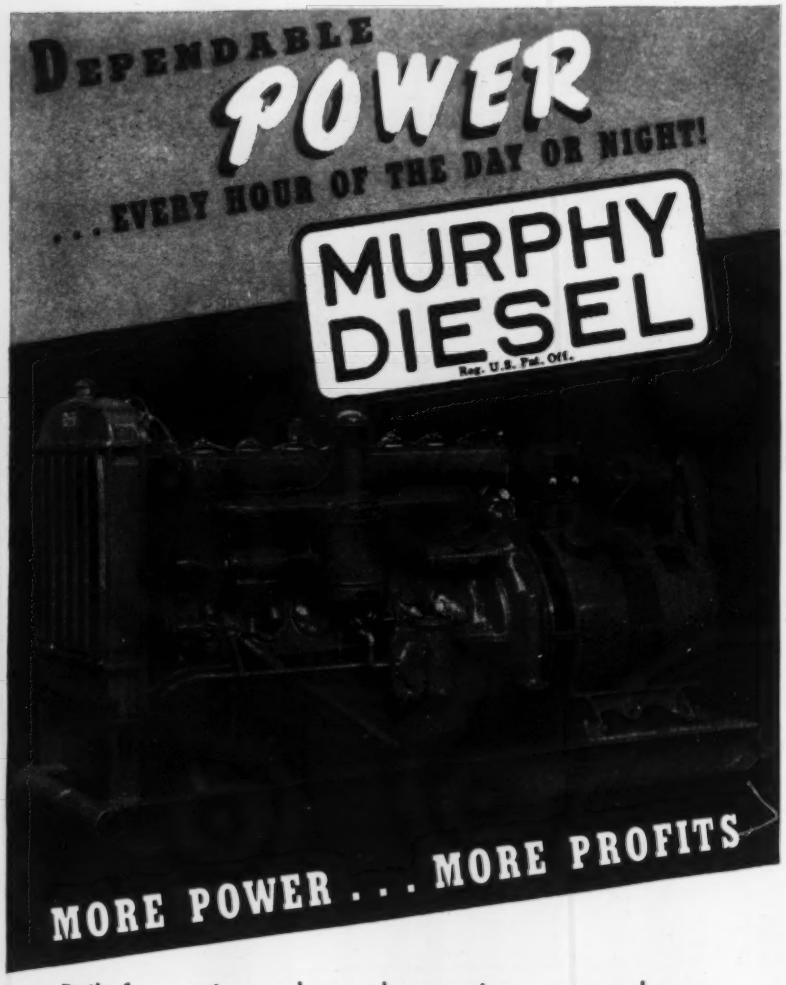

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turning to the use of prefabricated structures. Such structures are made by the Lindsay Structure Division, Dry-Zero Corp. By using a light steel, the fabricated structure, composed of standard framing and members, storage and office buildings can be completed in half the time it would take with conventional construction material.—*Lindsay Structure Division, Dry Zero Corp., Chicago, Ill*

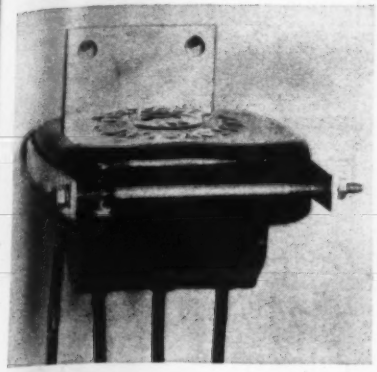
Coolant Strainer

Installation of the Metex coolant strainer shown above on turret lathes, screw machines, milling, drilling and all other metal-cutting machinery using a coolant flow is said to save production interruptions, labor costs, pump gears, coolant pumps and coolant lubricant. The strainer will eliminate metal chips and cuttings remaining in suspension, permitting only chip-free cooling solution to pass through the pump.—*Metal Textile Corp., Orange, N. J.*

Bag Fillers

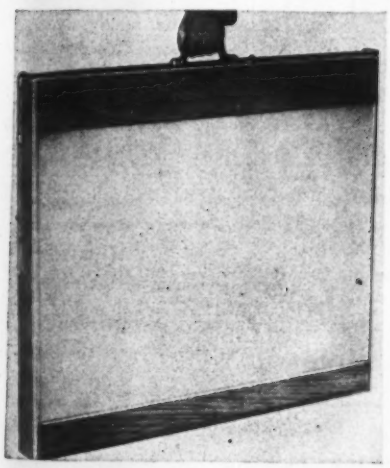
A new patented sand bag filler making it possible for a single man to fill more sand bags per day than was possible for two men without use of the attachments, has been developed by the Spinks Scale Co. The filler allows the bag to rest on the ground while being filled, so that

the filler can be removed without lifting the bag, thus allowing row after row of bags to be filled around a single pile of sand.—*Spinks Scale Co., 656 Maryland Ave., S.W., Atlanta, Ga.*



Outdoor Protector

To safeguard watthour meters and secondaries of transformers against lightning, a new outdoor protector is announced by the Westinghouse Electric & Mfg. Co. With a cutoff line to ground rating of 500 volts r.m.s., the unit is for application on 3-phase circuits of 110 to 575 volts. Discharge capacity is 20,000 amperes crest, and gap breakdown on impulse is 2500 volts average.—*Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.*



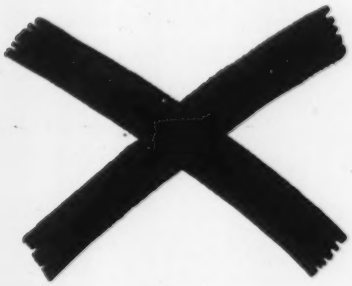
Portable Tracing Board

A compact, space saving portable tracing board has been developed by the Hamilton Mfg. Co. Usable without extra table space, the board is equipped with fluorescent lamps and adjustable stop rods to hold it in place when used on an inclined surface.—*Hamilton Mfg. Co., Two Rivers, Wisc.*

Care of Wire Rope

Representing a new endeavor in the way of publications, the MacWhyte Co.

Just put your



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has just issued a bulletin called "Ropeology," which is made available to all customers and gives detailed explanations of how to preserve and prolong the life of wire rope. The bulletin goes into detail as to damage done by improper sheaves and other "occupational diseases" of rope and explains methods of avoiding such trouble.—*MacWhyte Co., Kenosha, Wis.*

Torqometer

Incorporating a principle never before harnessed to the task of measuring the tension of nuts and bolts, an improved Snap-on Torqometer has recently been placed on the market. The new Torqometers, to all practical purposes, are free from any inherent friction, assuring the torque readings as accurate and not not affected by friction in the tool itself.—*Snap-on Tools Corp., Kenosha, Wis.*

Asphalt Tile

The development of a new type of asphalt tile designed to prevent accumulation of static electricity has been announced by the Building Materials Div. of the Armstrong Cork Co. The new material, to be known as Armstrong's conductive asphalt tile, provides a surface condition which results in less than .1 megohm resistance to static electricity under certain specific conditions. An additional safety feature of this flooring is that no open flames are required during installation or repair work.—*Armstrong Cork Co., Lancaster, Pa.*

Drafting Pencil

A new mechanical drafting pencil with a motor-driven lead pointing machine, for engineers, architects and mechanical draftsmen, has been announced by the TEC Pencil Co. This pencil has a full length lead tube of spring brass, driven downward into the chuck point by a screw operated mechanism providing a positive grip on the lead and preventing slippage or wobble. The pencil barrel is made of a light weight Tenite. It is perfectly balanced and has the feel of a full length wood-encased pencil. The clumsy metal tip found in European made drafting pencils has been eliminated.—*TEC Pencil Co., 9381 Olympic Blvd., Beverly Hills, Calif.*

HEIL HI-SPEED TRACTOR SCOOP gives you faster dirtmoving at lowest cost per yard

Heil Hi-Speed Tractor Scoop. 15-Yard Scoop pulled by 150 H.P. Heil Rubber-Tired Diesel Tractor.

Heil Hydraulic Trailbuilders and Bulldozers. Built in sizes for all Cletrac Tractor Models.

Speed up operations—Move bigger yardage, faster and cheaper—with Heil Hi-Speed Tractor Scoops

For faster dirtmoving and bigger yardage on long haul jobs, investigate the extra economies and profitable capacity of Heil Hi-Speed Tractor Scoops. These 15 Yard Units are quickly push-loaded in 40 to 50 seconds — they haul at travel speeds up to 20 M.P.H., depending on road and grade conditions — and they spread their loads quickly with a positive mechanical pushout action secured by tilting the floor of the bowl.

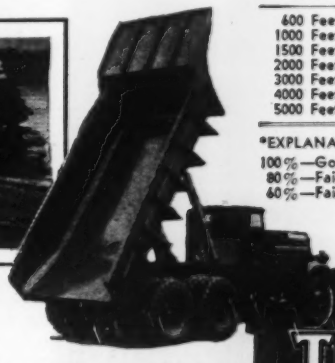
Quick acceleration and higher travel speeds insure faster operation — and allow users of Heil Hi-Speed Units to show a profit on jobs where slower earthmoving operations would not be practical. Consult the chart below and compare the Heil Hi-Speed yardages with those you are now moving with conventional equipment. With a 100 H.P. Crawler Tractor push-loading, you can expect to move the following "Pay Dirt Per Hour."

One-Way Haul	ROAD CONDITIONS* 100%	80%	60%
600 Feet	300 Cu. Yd.	240 Cu. Yd.	180 Cu. Yd.
1000 Feet	270 Cu. Yd.	216 Cu. Yd.	162 Cu. Yd.
1500 Feet	225 Cu. Yd.	180 Cu. Yd.	135 Cu. Yd.
2000 Feet	180 Cu. Yd.	144 Cu. Yd.	108 Cu. Yd.
3000 Feet	138 Cu. Yd.	110 Cu. Yd.	83 Cu. Yd.
4000 Feet	108 Cu. Yd.	86 Cu. Yd.	65 Cu. Yd.
5000 Feet	95 Cu. Yd.	76 Cu. Yd.	57 Cu. Yd.

*EXPLANATION OF ROAD CONDITIONS
100%—Good Haul Road—High Gear Output
80%—Fair to Good Haul Road—Some 3rd & 4th Gear Speed
60%—Fair Haul Load—2nd and 3rd Gear Loaded—3rd and 4th Gear Return

Above figures based on 12.5 Cu. Yd. "Payload"—50 Second Loading Time, and 35 Second Dumping and Turning Time.

Heil Twin-Cable Scoops. 6 to 25 Yd. Capacities for use with any make of Crawler Tractor.



Heil Hydraulic Dump Units, available in sizes and capacities for mounting on any make of truck.

THE HEIL CO.
General Offices: Milwaukee, Wisconsin

REINFORCING MESH

Installs Faster - Saves Man Hours

The life and service of essential concrete construction depends upon the design of its self-contained armor. When this reinforcing is Steelcrete Expanded Metal Mesh you can be sure that it will stand up under severe usage. Its DIAMOND MESH has high bond resistance. It cannot slip within the concrete. Its design diffuses temperature stresses in all directions. It nests perfectly, thereby saving valuable storage space and allows trucks to be loaded to capacity. Its large flat sheets are quickly and easily installed, saving many valuable man-hours.

"IT'S WHEELING STEEL"

OTHER STEELCRETE PRODUCTS TO ACCELERATE VICTORY

EXPANDED METAL GUARDS *for Men and Machines*

EXPANDED METAL GUARDS *for Windows and Doors*

EXPANDED METAL MESH *for Partitions and Enclosures*

EXPANDED METAL WALKWAY MESH *for Catwalks, etc.*

LITERATURE UPON REQUEST

Steelcrete, the ideal reinforcing Armor *for an industrial floor that must take punishment.*

THE CONSOLIDATED EXPANDED METAL COMPANIES
WHEELING, WEST VIRGINIA
Quick Shipments from 14 Warehouses

NEW PUBLICATIONS

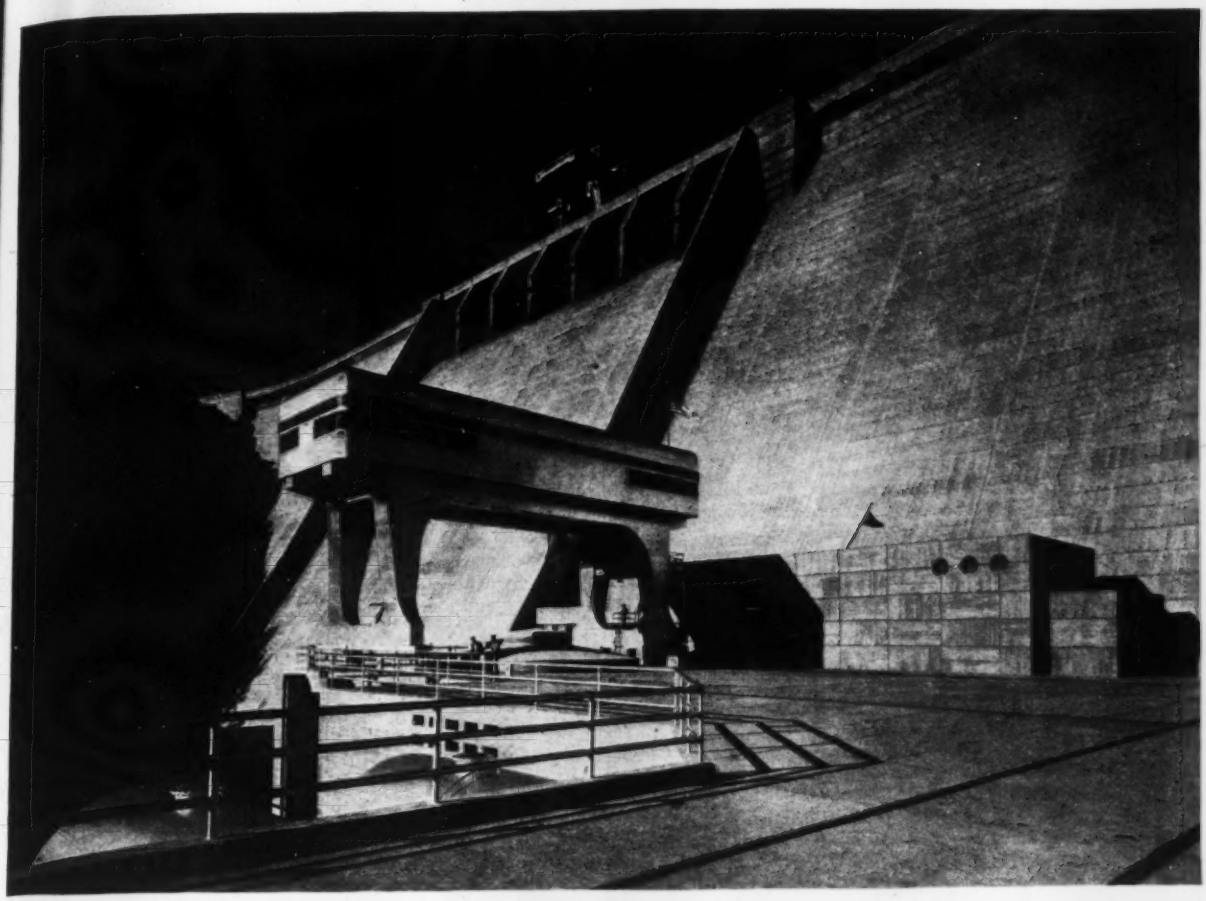
Wire Rope—A handsome catalog designed to answer questions of users, including how priorities and allocations affect supplies, has been issued by the Broderick & Bascom Rope Co. The profusely illustrated 31-page catalog, released as a guide to purchasers, includes advice on conserving wire supplies now on hand; advises the taking of inventory and gives procedure for ordering new supplies; gives a bibliography of booklets available on the subject of the use of rope, and stresses the advantages of the company's own "Yellow Strand" preformed wire rope.—*Broderick & Bascom Co., St. Louis, Mo.*

Alloy Steel—Four new series of alloy steels are announced by the American Iron & Steel Institute in a 114-page book on "Possible Alternates for Nickel, Chromium and Chromium-Nickel Construction Alloy Steel," prepared at government request by a committee of metallurgists. This group made a series of tests which was hitherto untried chemical compositions, seeking needed substitutes in the alloy field. The booklet gives data on a series of alloys investigated and points out that the use of alternate steels may necessitate changes in the established methods of heat treatment, fabrication and even engineering design.—*American Iron & Steel Institute, 350 Fifth Ave., New York, N. Y.*

Joints and Water Seals — Servicised Products Corporation has just completed a new catalog of compiled facts on expansion joints and water seals. Servicised is the only manufacturer of all of the different types of expansion joints listed in this catalog, being pioneers in this field for over 22 years.—*Servicised Products Corporation, Chicago, Ill.*

Oil — A comprehensive 72-page pocket type lubrication handbook, contains lubrication specifications, gives the crankcase, gear case, wheel bearings, chassis, water pump, universal joint, clutch release bearing and covered spring recommendations for passenger cars as well as specifications for trucks and tractors. In addition, the booklet has crankcase recommendations for industrial, marine, aviation, fire apparatus, motor bus and motorcycle engines.—*Valvoline Oil Company, Cincinnati, Ohio.*

Steaming Capacity — As an aid to power engineers who are faced with the necessity of meeting sharply increased steam demands, the Bailey Meter Co. has prepared a 20-page bulletin, No. 16, entitled, "How to Safely Stretch Steaming Capacity."—*The Bailey Meter Co., Cleveland, Ohio.*



TALLEST STRUCTURE OF ALL TVA DAMS

The Hiwassee Dam located in North Carolina is a 307-foot structure of outstanding design. SERVICISED supplied various types of expansion joint materials for this gigantic dam. Premoulded Cork-Rubber Expansion Joint, Asphalt Expansion Joint and Para-Plastic Hot-Poured Sealing Compound were used in this construction. Incidentally, Para-Plastic, our hot-poured sealing compound insures a positive joint seal regardless of contraction or expansion of concrete slabs.

Servicised Products serve the construction industry from coast to coast and are especially active in numerous Government Projects.

SERVICISED is the only manufacturer of all of the different types of expansion joints, namely: Asphalt, Fiber, Cork, Cork-Rubber, Self-Expanding Cork, Sponge Rubber and Waterstop.

Pioneers in the Expansion Joint Field for Over Twenty-Two Years.

ENGINEERS AND OFFICIALS:

Be sure to send for the new 1942 Catalog on Expansion Joints and Water Seals.

SERVICISED PRODUCTS CORP.

6051 WEST 65TH STREET CHICAGO, ILLINOIS

THIS W&T

Safety Service

GIVES YOU

HEALTH DEFENSE . . . today

Wallace & Tiernan representatives are on the job to help you increase the safety of water supplies against possible air raids, sabotage and other emergency conditions. Their suggestions are based on information obtained from "blitzed" areas in England, as well as from American military and civilian defense authorities. They can advise on procedures already being followed at critical coastal points.

A safety check-up of your present chlorinating facilities and operating methods may reveal simple changes that make for greater safety.

Where new equipment is needed for essential jobs such as secondary chlorination of open distribution reservoirs, emergency sterilization of broken mains, and the like, you will find W&T ready to be of service with complete data, equipment and service.

BUDGET DEFENSE . . . tomorrow

As you equip yourself to assure higher standards of safety for the war emergency, remember that an investment in W&T chlorinating equipment has sound peacetime value as well. Today's acute public consciousness of the need for safe water can be acted upon with full confidence that you're making a constructive move for the future.

Protection against floods, fires and other natural emergencies will always be necessary. Moreover, problems of taste and odor control, and other water treatment steps required for improved palatability, can usually be met by the same highly flexible equipment now so necessary to safeguard health.

Your W&T Representative will work with you in extending your chlorination facilities in a way that's soundly planned for long term satisfaction and low operating expense. Call him today, or write direct for Technical Bulletins giving facts and figures. SA-131-S

We'll be seeing you at The A.W.W.A. Convention STEVENS HOTEL • CHICAGO JUNE 21—25, 1942

"The Only Safe Water is a Sterilized Water"

WALLACE & TIERNAN CO., Inc.

MANUFACTURERS OF CHLORINE AND AMMONIA CONTROL APPARATUS

NEWARK, NEW JERSEY • REPRESENTED IN PRINCIPAL CITIES

Approved "Dandux" Canvas

For true "long run" economy, greater durability and satisfaction, buy "DANDUX" for all Canvas uses. Though the major portion of our facilities are devoted to the requirements of our Armed Forces, we pledge the supply of all requirements to the best of our ability, subject only to existing regulations and restrictions.

C. R. DANIELS, INC.

101 Crosby St. New York, N. Y.

Newark Boston Chicago Cleveland Buffalo Detroit Hartford Milwaukee Philadelphia Pittsburgh Alberton, Md.

Manufacturers' Activities

The CLEAVER-BROOKS CO., manufacturers of boilers and water distilling equipment, has purchased the factory and site of the Andres Stone & Marble Co., at 326 E. Keefe Ave., Milwaukee, Wis., to provide approximately 55,000 sq.ft. of factory space and 8 acres of land for expanding production facilities, in addition to the company's main plant at 5100 N. 33rd St., Milwaukee.

GOULD'S PUMPS, INC., whose main office and factory is at Seneca Falls, N. Y., has established a Washington, D. C., office with J. B. Darden in charge. The new office is located at 505 Colorado Building, 14th and G Sts., Washington.

P. A. STYAN has been appointed manager of the British Columbia branch of WESTERN STEEL PRODUCTS CORP., LTD., at Vancouver, B. C.

The RHEEM MFG. CO. has purchased the plant of the AMERICAN RADIATOR & SANITARY MFG. CO. at 2901 35th Ave., North Birmingham, Ala., and will put the plant into war production as soon as practicable. The Rheem Co., whose home offices are at Richmond, Cal., said the plant just purchased has an estimated 100,000 sq.ft. of floor space and is located on a 14-acre tract.

ROY I. REYNOLDS has been made assistant manager of the Governmental Sales Division for the CATERPILLAR TRACTOR CO. of Peoria, Ill.

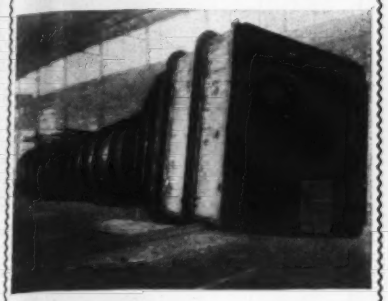
The CUMMINS DIESEL ENGINE CORP. of New City, N. Y., has announced the appointment of CHARLES D. CAVETT as advertising and sales promotion manager.

J. B. COLESWORTHY has been appointed Los Angeles district sales representative of the CROCKER-WHEELER ELECTRIC MFG. CO.

C. J. MCNALLY has been appointed general manager of the CEMENT GUN CO., and R. N. GILLESPIE has been appointed chief engineer for the same organization, according to a recent announcement.

G. ARTHUR GUSTAFSON, formerly manager of the Meriden and Taunton divisions of the GENERAL ELECTRIC plastics department, has been appointed to the newly created post of supervisor of manufacturing of the department, according to WILLIAM H. MILTON, JR., plastics department manager. JAMES D. MILNE, Fort Wayne division manager,

PENSTOCKS



Designed for quality, economy and long life. Fabricated from Class "A" steel, alloy steel or wrought iron.

Consult Lancaster's experienced engineers when you have a problem in fabricated steel plate work. Complete designs and estimates will be submitted with no obligation to you. Write, 'phone or wire today.

LANCASTER IRON WORKS, INC.
LANCASTER, PENNA.

Compact! Powerful! Safe!

DISTRIBUTABLE CONTROLLED POWER
with Beebe Bros. ALL STEEL HAND HOIST
SEATTLE, U.S.A.

★

Money Has Been Saved on These Jobs

1200' assembled pipe (132 Tons) were lowered to bed of Mississippi at St. Paul with 9—5-Ton Beebes, three lines to each hoist through blocks.
Hudson River Bridge sidewalks were laid in sections with 32—5-Ton Beebes.
Longest wooden trusses in world were installed with ONE 5-Ton Beebe after power hoists proved impractical.

★

When raising, lowering, or placing costs by power are a serious problem, the answer is the right number of Beebe Bros. All Steel Hand Hoists MANNED IN UNISON. Available in 2, 5 and 15 Ton sizes. Sold through leading dealers in all trade centers. List of dealers sent upon request.

BEEBE BROS., 2720 6th Ave. S., Seattle, U.S.A.

★

"THE STRONGEST GEARED POWER FOR ITS WEIGHT IN THE WORLD"

has been transferred to succeed Mr. Gustafson at Meriden, and CLARENCE W. COE and EVERETT W. BICKFORD have been appointed division managers at Fort Wayne and Taunton.

The GOODYEAR TIRE & RUBBER CO., of Akron, Ohio, has announced the transfer of A. C. MICHAELS, general superintendent of the Gadsen, Ala., factory; A. B. MATTHEWS, manager of the Akron labor division, and J. R. ARNDT, manager of the Goodyear restaurants, to the expanding GOODYEAR AIRCRAFT CORP., a subsidiary.

The BASS ENGINEERING & CONSTRUCTION CO., of Minneapolis, Minn., has moved its offices to the Birmingham Theatre Bldg., Birmingham, Mich.

GAIL SPONSLER, formerly connected with the WHITE TRUCK CO. at Chicago, has been appointed sales manager of the POWER EQUIPMENT CO., of Denver, Colo.

HOWARD F. GURNEY, director of engineering, research and production for the OTIS ELEVATOR CO., died March 23 at his home in New York City. Mr. Gurney, 72, was founder and head of the National Elevator Co., which in 1911 became the GURNEY ELEVATOR CO. He joined the Otis Co. in 1932.

ALLEN E. BAILEY, JR., and WILLIAM D. COCKRELL have been appointed as manager of sales and engineer, respectively, of a newly organized electronic control section of GENERAL ELECTRIC CO.'s industrial control division.

CHARLES R. WEBB, 84, retired sales manager of the AMERICAN STEEL AND WIRE COMPANY in Worcester, Mass., died March 22 at Shrewsbury, Mass.

The AMERICAN CONCRETE AND STEEL PIPE COMPANY, of Los Angeles, Cal., has announced a change in its name to THE AMERICAN PIPE AND CONSTRUCTION COMPANY.

To increase the production of seamless tubing of alloy and stainless steel, essential to the war effort, UNITED STATES STEEL CORPORATION has announced the creation of TUBULAR PRODUCTS, INC., a new subsidiary company, which will begin operations shortly, has acquired the existing plant of the NATIONAL TUBE company in the Chicago district at Gary, Indiana.

J. B. WIESEL, director of sales of the cellulose products department of the HERCULES POWDER COMPANY has been appointed advisor to J. B. DAVIS, chief of the Protective and Technical Coating Section, War Production Board.

SAVE TIME

and save expense by making your Grab Bucket Equipment *more effective*

A SINGLE Drum Hoist becomes a TWO Drum Hoist.

A TWO Drum Hoist becomes a THREE Drum Hoist.

How? Simply by adding another DRUM to your present hoist.

It works independently—without gears—and is worth looking into.

We have several of these DRUMS in stock—and can make immediate shipment.

Drop us a line, get full information.

THE HAYWARD COMPANY
Builders of Grab Buckets
For Every Digging and Rehandling Need
50 CHURCH STREET, NEW YORK, N.Y.

EXPANSION JOINTS MADE EASY

with "Qwik-Lock" UNIT

Patented

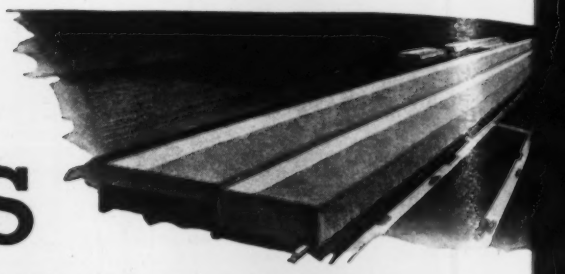
This new improved Union Dowel and Joint Assembly Unit assures lower cost, simplified installation, and fool-proof, trouble-free functioning.
Dowels are accurately positioned and locked parallel to each other and to the subgrade.

SEE OUR CATALOG IN SWEET'S

Write for Catalog of Construction Accessories

UNION STEEL PRODUCTS CO.
417 Pine St. Albion, Mich.

Truscon FERROGLAS CONSTRUCTION . . .

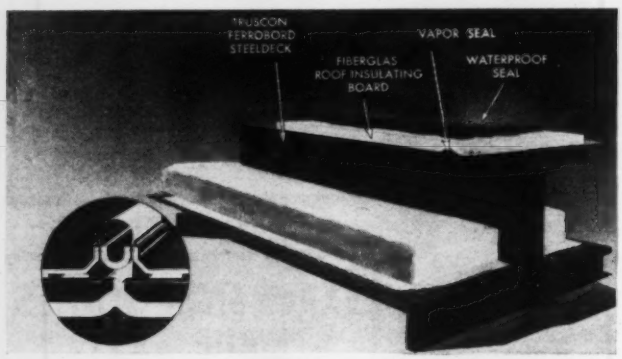


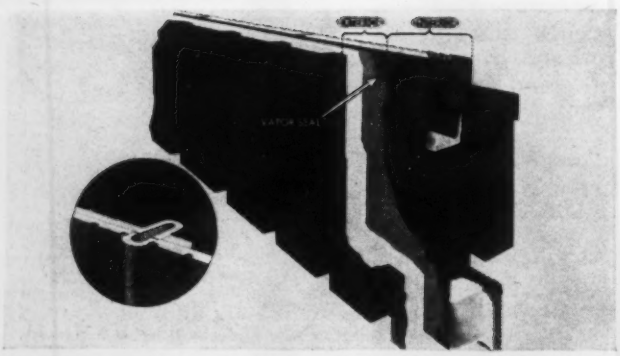
A Practical Solution to the Problem of "Specific-Purpose-Building" Design

Today, *speed* is America's most urgent need in meeting the enormous demands of wartime production. Certain buildings, because of function or location, require one, several or all of these features:

Air Conditioning • Shadowless Lighting • Sound Absorption • Fire- and Shatter-Resistance

Truscon Ferroglas Construction offers these advantages singly or in any required combination. Experience to date has demonstrated that a Ferroglas constructed building need cost no more than many types of conventional industrial structures.





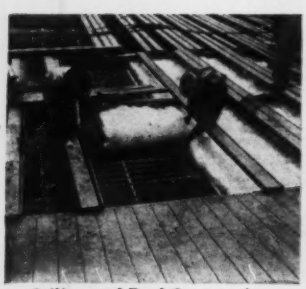
The Complete Ferroglas Roof and Ceiling

The total weight of a Ferroglas roof and ceiling does not exceed eleven pounds per square foot! This includes the Truscon Ferrobord steel roofdeck, Fiberglas insulation, expanded metal guard, vapor seal and built-up waterproofing. This type of roof and ceiling construction provides complete weatherproofing, freedom from condensation, strength to carry superimposed loads and the required degree of sound absorption and light reflection.

The Complete Ferroglas Sidewall

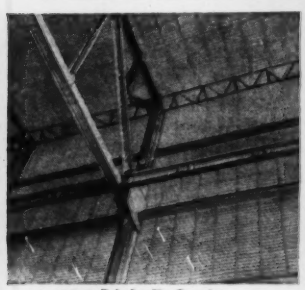
Ferroglas sidewalls are erected from a single outside scaffolding! Due to the design, the exterior facing panels establish an air space between the Fiberglas insulation and the outside wall. This acts as a flue carrying a continual current of air which dries any moisture that might, under extreme conditions, condense within the outside insulation. Expansion joints in roof and sidewalls, installed at 400′ intervals, allow for 2¾″ movement of the structural frame of the building without disturbing the insulating qualities.

Write Today For A New Booklet That Describes Ferroglas Construction

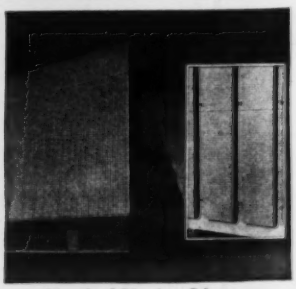


Ceiling and Roof Construction

Application of the Vapor Seal



38% Light Reflection



Vertical Shadow Lines

TRUSCON STEEL COMPANY YOUNGSTOWN • OHIO
SUBSIDIARY OF REPUBLIC STEEL CORPORATION